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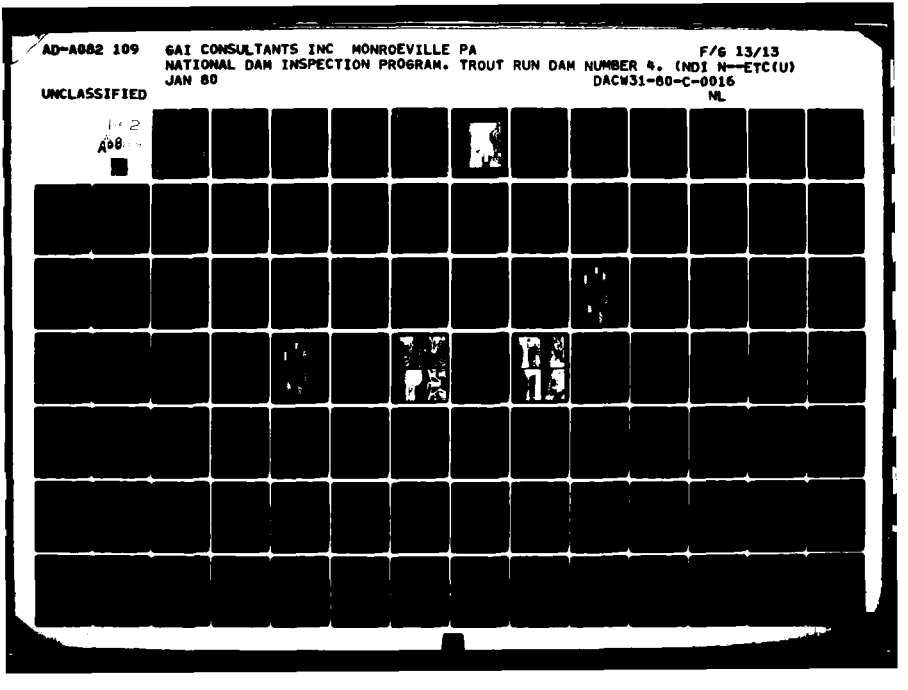

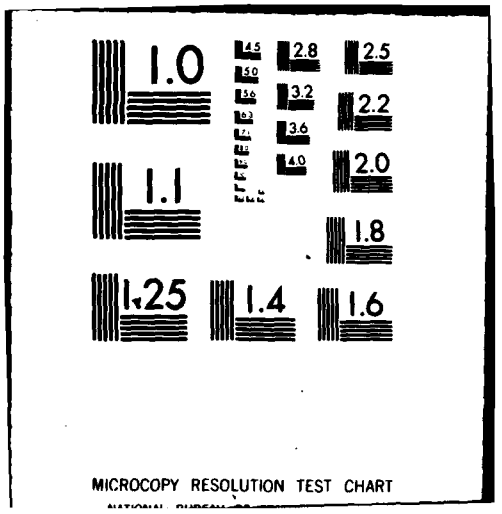
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SUSQUEHANNA RIVER BASIN
TROUT RUN, NORTHUMBERLAND COUNTY

PENNSYLVANIA

TROUT RUN DAM NO. 4

NDI I.D. No. PA-00512
PENNDER I.D. No. 49-5

DACW-31-80-C-0016 NAW

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

JANUARY 1980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314: The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topograhic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

A 2-3

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Trout Run Dam No. 4: NDI I.D. No. PA-00512

Owner:	Roaring Creek Water Company
State Located:	Pennsylvania (PennDER I.D. No. 49-5)
County Located:	Northumberland
Stream:	Trout Run
Inspection Date:	6 November 1979
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

The visual inspection, operational history, and hydrologic/hydraulic analysis indicate that the facility is in good condition.

Deficiencies noted by the inspection team included slumping and bulging of the rock surface on the steep downstream embankment slope, minor seepage along the downstream embankment toe and minor deterioration of the control tower. In addition, the growth of large trees in the immediate area of the downstream toe is a hindrance to expedient visual evaluation of the embankment.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possibly loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only 27 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased downstream damage and potential for loss of life. Thus, based on screening criteria provided in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

It is recommended that the owner immediately:

a. Develop a formal emergency warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

b. Remove the masonry blocks located atop the spillway crest and adjacent the wingwalls and seal all cracks in the spillway channel floor.

c. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams and take remedial measures deemed necessary to make the facility hydraulically adequate.

d. Develop formal manuals of operation and maintenance to ensure the continued proper care of the facility.

e. Remove and/or trim the trees located immediately beyond the downstream embankment toe to provide an unobstructed view of the facility.

f. Specifically address in all future inspections the bluging and slumping of the downstream embankment face and seepage along the downstream embankment toe noting any significant changes.

GAI Consultants, Inc.

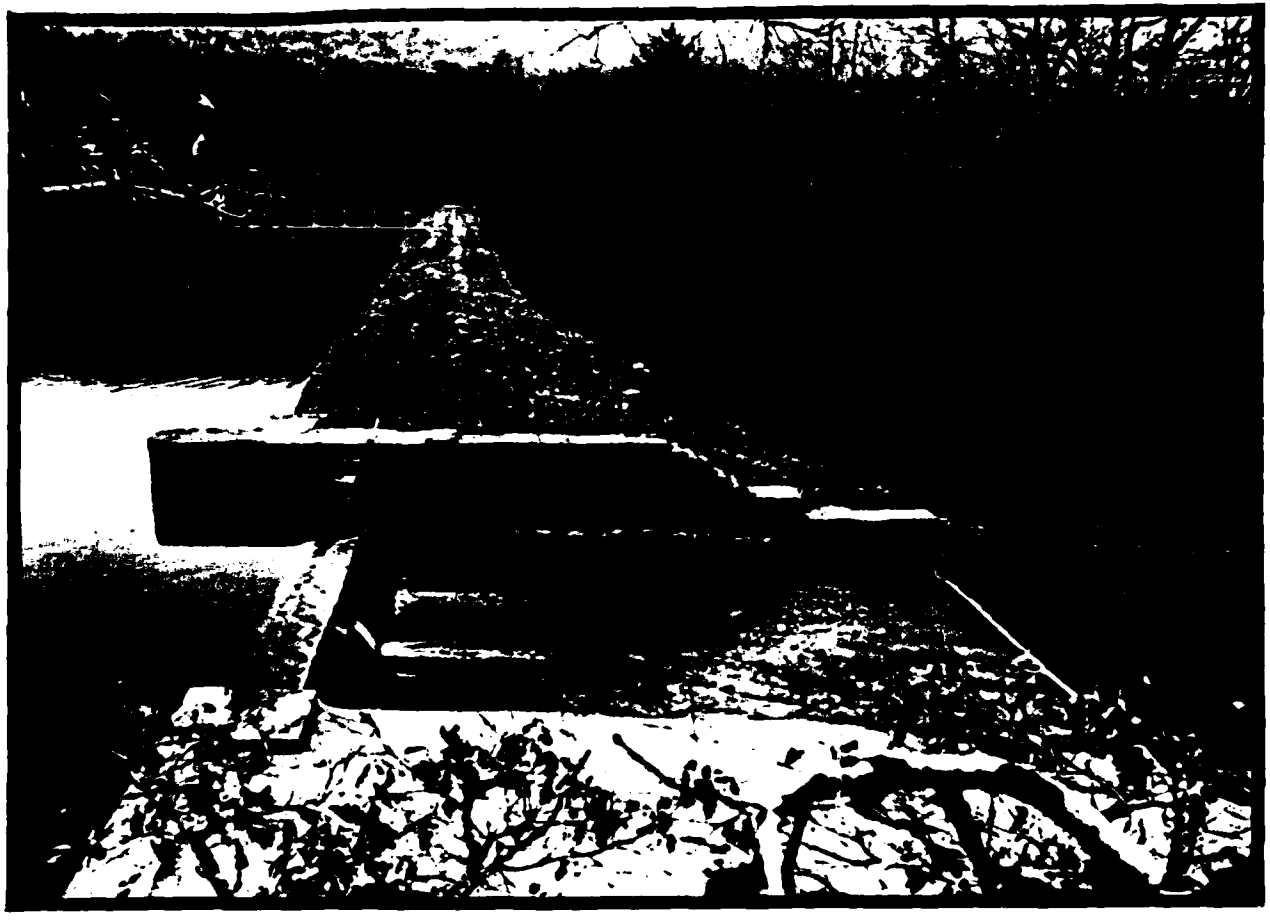
Bernard M. Mihalcin, P.E.

Date 12 Feb 1980
DLB:BMM/sam

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE: 12 March 1980



OVERVIEW PHOTOGRAPH

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NATIONAL DAM INSPECTION PROGRAM.
TROUT RUN DAM [redacted] Number 4.
(NDI [redacted] PA-00512, PENNDER[redacted]S Number 49-5)
Number

[redacted]

Susquehanna River Basin, Trout Run.
Northumberland County, Pennsylvania.
Phase I Inspection Report.

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers to initiate a program of inspection of dams throughout the United States.

(15) DACW31-80-C-0016

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

(11) Jan 80 / (12) 100

1.2 Description of Project.

a. Dam and Appurtenances. Trout Run Dam No. 4 is an earth embankment approximately 30 feet high and 505 feet long (including spillway). The facility is provided with a two-stage, uncontrolled, service-emergency spillway located at the right abutment. The combined spillway crest length is approximately 55 feet. A reinforced concrete control tower is located along the upstream embankment toe near the center of the dam. Access to the tower is provided by a steel framed footbridge. The outlet works housed within the tower consists of a 16-inch diameter cast iron supply pipe and a 16-inch diameter cast iron blowoff pipe.

b. Location. Trout Run Dam No. 4 is located on Trout Run in Coal Township, Northumberland County, Pennsylvania, about 2 miles north of Shamokin, Pennsylvania. The dam, reservoir, and watershed are contained within the Shamokin, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N40° 48.7' and W76° 32.9'.

c. Size Classification. Small (30 feet high, 155 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

411002 AM

e. Ownership. Roaring Creek Water Company
204 East Sunbury Street
Shamokin, Pennsylvania 17872

f. Purpose. Water supply.

g. Historical Data. Drawings and records contained in PennDER files indicates that Trout Run Dam No. 4 was originally constructed in 1882 by the Shamokin Water Company. The structure was modified to its present configuration in 1894 by the Roaring Creek Water Company which acquired the facility in 1884.

The watershed in which the dam is located has a long recorded history of heavy flooding. A state report on the facility dated 1915 states "the region receives nearly as heavy an annual rainfall as any portion of Pennsylvania." The same report recommended the spillway capacity be increased in compliance with then applicable state guidelines. The spillway was subsequently modified to its present configuration in 1920.

Deficiencies noted in available state inspection reports between the years 1925 to 1946 include; 1) settlement across the embankment crest (apparently corrected) and subsequent bulging of the downstream face, and 2) seepage between the spillway and blowoff.

A representative of the owner stated that the spillway structure sustained minor damage from the floods of 1972 and 1975 and was renovated in 1978.

1.3 Pertinent Data.

a. Drainage Area (square miles). 1.9

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool = 1060 cfs (see Appendix D, Sheet 11).

c. Elevation (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements that were based on the elevation of the service spillway crest at 878.5 feet (see Appendix D, Sheet 1).

Top of Dam	882.0 (design) 881.9 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	Not known
Normal Pool	878.5
Service Spillway Crest	878.5
Emergency Spillway Crest	878.8
Upstream Inlet Invert	853.5 (estimated)
Downstream Inlet Invert	851.7
Streambed at Dam Centerline	852.0 (estimated)
Maximum Tailwater	Not known

d. Reservoir length (feet).

Top of Dam	1350
Normal Pool	1300

e. Storage (acre-feet).

Top of Dam	155
Normal Pool	108
Design Surcharge	Not known.

f. Reservoir Surface (acres).

Top of Dam	16
Normal Pool	12
Maximum Design Pool	Not known.

g. Dam.

Type	Earth.
Length	505 feet (including spillway).
Height	30 feet (field measured; crest to downstream blowoff invert).
Top Width	13 feet.
Upstream Slope	2.5H:1V.
Downstream Slope	1.25H:1V to 1.5H:1V (varies).
Zoning	Homogeneous earth (see Figure 5).

	Impervious Core	Plank corewall reportedly along embankment centerline.
	Cutoff	None indicated.
	Grout Curtain	None indicated.
h.	Diversion Canal and Regulating Tunnels.	None.
i.	Spillway.	
	Type	Two-stage, uncontrolled, service-emergency spillway located at right abutment (see Figure 3).
	Crest Elevation (service)	878.5 feet.
	Crest Elevation (emergency)	878.8 feet.
	Crest Length (service)	30.4 feet.
	Crest Length (emergency)	24.5 feet.
j.	Outlet Works.	
	Type	Supply - 16-inch diameter cast iron pipe. Blowoff - 16-inch diameter cast iron pipe.
	Length	140 feet (estimated; inlet to blowoff outlet).
	Closure and Regulating Facilities	Flow through both conduits are controlled via 16-inch diameter gate valves located

	within a concrete control tower (see Figure 5). In addition, the blowoff conduit is equipped with a 16-inch diameter gate valve located near the outlet.
Access	Steel framed footbridge from crest (see Photograph 3).

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No formal design reports or calculations are available for any aspects of the facility. Several drawings of the facility are available from both the owner and PennDER files including; 1) drawings of the original facility dated 1894 (see Figures 2 and 5); 2) a drawing showing modifications to the spillway dated 1916 (see Figure 4) and; 3) a drawing of the latest spillway renovation dated 1977 (see Figure 3).

b. Design Features.

1. Embankment. Little information is available relative to the physical characteristics of the embankment. Available drawings indicate the embankment to be composed of homogeneous earth with no distinct zoning (see Figure 5). Reports contained in PennDER files indicate the original embankment was constructed with 1H:1V side slopes and a plank corewall along the centerline. The upstream slope was later flattened to 2.5H:1V and protected by a layer of gravel (large crushed stone) while the downstream face was covered with hand-placed sandstone slope protection.

2. Appurtenant Structures.

a) Spillway. The spillway is an uncontrolled, two-stage, service-emergency spillway located at the right abutment. The service spillway occupies the left portion of the structure and has an ogee-like weir crest that is 30.4 feet long. The emergency spillway occupies the right portion of the structure. It has a flat overflow crest that is 24.5 feet long and is set 0.3 feet above the crest of service spillway (see Figure 3). The entire structure is keyed with concrete beneath the overflow crest and is supported on steel sheet piling at the downstream end (see Photograph 7).

b) Outlet Works. The outlet works consist of two 16-inch diameter cast iron blowoff and supply lines. Both conduits originate at the base of the concrete control tower located on the upstream embankment face and can be regulated at this location by 16-inch diameter gate valves operated from within the tower. The blowoff line is also valved near the outlet.

c. Specific Design Data and Criteria. No formal design reports, calculations or specific design data are available for any aspect of this facility.

2.2 Construction Records.

No records of any phase of the original construction of the facility are available.

2.3 Operational Records.

Formal records of daily rainfall and spillway discharge are available dating back to circa 1880. Rainfall is currently measured by a gauge located atop the roof of the owner's main office in downtown Shamokin. Spillway discharges are estimated from water level datums painted on the exterior wall of the control tower. No standard staff gauge was observed.

2.4 Other Investigations.

No records of any formal investigations other than periodic state inspection reports are available. The inspection reports are contained in PennDER files.

2.5 Evaluation.

The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests that it is in good condition.

b. Embankment. The visual inspection indicates that the embankment is in good condition and adequately maintained. The crest is protected with a layer of crushed stone and is well aligned vertically and horizontally. The gravel slope protection provided on the upstream face appears adequate for this facility. The downstream face is somewhat irregular as minor bulging and slumping of the stone slope protection was observed (see Photograph 2). Some minor seepage was observed across the downstream embankment toe over an area that extends from the blowoff near the left abutment to approximately 120 feet left of the spillway. No measureable flow was observed at any particular location. Large trees occupy the general area along the immediate downstream embankment toe and obstruct the overall view of the facility (see Photograph 1).

c. Appurtenant Structures.

1. Spillway. The overall condition of the spillway is good. Minor seepage through the channel floor of the emergency portion was observed but, was not measurable. Masonry blocks have been placed adjacent the wingwalls and atop the spillway crest to serve as stepping stones into and out of the channel (see Photographs 6 and 7). The blocks are considered an obstruction to free flow and should be removed.

2. Outlet Works. The outlet works are reportedly functional although they were not operated in the presence of the inspection team. The concrete control tower is in fair condition exhibiting minor exterior concrete deterioration (see Photograph 3).

d. Reservoir Area. Trout Run Dam No. 4 is situated in a valley which is confined to the north and south by practically parallel ridges that are heavily forested and have moderate to steep slopes. No evidence of slope distress was observed.

e. Downstream Channel. The spillway discharges into Trout Run which cuts through a narrow, forested valley with

steep confining slopes. The stream, on a steep gradient, converges with Shamokin Creek approximately 1.3 miles downstream of the embankment. The left bank of Shamokin Creek, opposite the inlet of Trout Run, is heavily developed in this area with both industrial and residential structures. Several hundred people reside and/or work in this area. Substantial property damage and loss of life could possibly be incurred in this area as a result of an embankment breach due to the close proximity of the structures to the stream.

3.2 Evaluation.

The overall condition of the facility is considered to be good. Deficiencies noted by the inspection team include slumping and bulging of the downstream embankment face and minor seepage along the downstream embankment toe. Historical accounts contained in PennDER files indicate these conditions to have been initially reported in the mid-1920's and again in the 1930's. Neither condition has changed significantly over the last 50 years and are considered minor at this time. The condition of the control tower is deteriorating; however, it remains functional.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The facility is essentially self-regulating. Excess inflow discharges through the spillway and is directed downstream. Under normal operating conditions the blowoff line is closed. The supply line is left open and is regulated at a distribution point downstream. All of the valves are reportedly functional, however, none were operated in the presence of the inspection team. No formal operations manual is available.

4.2 Maintenance of Dam.

The facility is maintained on an unscheduled basis as needed. No formal maintenance manual outlining maintenance procedures is available.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

No formal warning system is in effect.

4.5 Evaluation.

No formal operations or maintenance manuals are available, but, are recommended to ensure the continued proper care and maintenance of the facility. In addition, no formal warning system is in effect.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports, calculations, or design data are available for any aspect of this facility.

5.2 Experience Data.

Formal records of daily rainfall and spillway discharge are available dating back to circa 1880. The inspection team checked the records for the floods of March 1936 and June 1972 which the owner's representative indicated were the largest floods experienced in the area. The records indicated the June 1972 event to be the largest flood on record when a total of 17.2 inches of rain fell from June 19 through June 25. The embankment was not overtopped in 1972, but, some damage was sustained by the spillway. Repairs to the structure were not initiated until the spillway was further damaged by a lesser flood that occurred in the fall of 1975. According to available records the embankment has never been overtopped.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway could not perform satisfactorily during a flood event within the limits of its design capacity. The masonry blocks set atop the spillway crest adjacent the wingwalls should be removed in that they do represent a minor obstruction.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U.S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U.S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Trout Run Dam No. 4 ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for loss of life and damage to the downstream residences and structures, the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Trout Run Dam No. 4 was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of approximately 878.5 feet, with the spillway weir discharging freely (masonry blocks removed) and the outlet conduit assumed to be closed. The spillway is a two-stage channel, consisting of a service spillway and an emergency spillway. Discharges through the service spillway are controlled by an ogee-like weir. Flows through the emergency spillway are controlled by a small flat-crested weir. The necessary downstream channel routing was done under the assumption that the routing stream was dry prior to the inflow of the dam discharge. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix D.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Trout Run Dam No. 4 can accommodate only about 27 percent of the PMF (SDF) prior to the overtopping of the embankment (Appendix D, Summary Input/Output Sheets, Sheet H). The low top of the dam was inundated by maximum depths of water of 0.7 and 1.5 feet under the 1/2 PMF and PMF events for 5.0 and 8.7 hours, respectively (Summary Input/Output Sheets, Sheet H). Since the SDF for Trout Run Dam No. 4 is the PMF, it can be concluded the dam has a high potential for overtopping, and thus, for breaching under floods of less than SDF magnitude.

As Trout Run Dam No. 4 cannot safely accommodate a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of less than 1/2 PMF intensity was investigated (in accordance with Corps directive ETL-1110-2-234). Several possible alternatives were examined, since it is difficult, if not impossible, to determine how or if a specific dam will fail. The major concern of the breaching analysis is the effect of the various breach discharges on downstream water surface elevations in comparison to those to be expected if breaching does not occur.

The Modified HEC-1 Computer Program was used for the breaching analysis, with the assumption that the breaching of an earth dam would begin once the water level of the reservoir reached the low top of dam elevation.

Five breach models were analyzed for Trout Run Dam No. 4. Two sets of breach geometry were evaluated for each of two failure times (Appendix D, Sheet 17). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for the breach section to reach its final dimensions) under which the two breach sections were investigated were assumed to be a rapid time (0.5 hours) and a prolonged time (4.0 hours), so that a range of this most sensitive variable might be examined. In addition, an average set of breach conditions was analyzed with a failure time of 2.0 hours.

Two potential damage centers were investigated in the analysis. The first area is located about 200 feet downstream of the confluence of Trout Run and Shamokin Creek (about 7600 feet downstream from the dam) where several houses are situated on the left bank. The damage level of the houses is approximately elevation 665 feet (MSL). Breach outflows from a 0.29 PMF storm routed to this point for the maximum section-minimum fail time scheme yielded a maximum water surface elevation of 662.5 feet (Summary Input/Output Sheets, Sheet M). The average breach failure scheme yielded a peak water surface elevation of 660.4 feet (MSL). Accordingly, for the conditions analyzed, the breach outflows result in water surface elevations somewhat below the damage level of the houses. However, other factors must be considered here. First of all, the effects of the railroad bridge located at the confluence of Trout Run and Shamokin Creek are uncertain and largely dependent on the structure's ability to withstand the force of the floodwave. Secondly, since Trout Run discharges approximately at a right angle into Shamokin Creek, it is apparent that the breach outflow will not remain completely within the main channel, but will probably inundate the overbank area around the confluence. Since the houses in question are located only about 200 feet downstream of the confluence near the stream, it is quite possible that they would indeed be flooded. In addition, numerous other failure schemes that allow for breaching of the embankment under larger base flood conditions and a more accurate survey of those residences within the reach would likely contribute to more conclusive results. Therefore, damage and loss of life at these residences due to the failure of Trout Run Dam No. 4 cannot be ruled out and a more detailed hydrologic and hydraulic study is required.

The second damage center analyzed was a group of houses located on the right bank of Shamokin Creek, about 9800 feet downstream of the dam, at approximately elevation 640 feet (Section 5). The water surface level here corresponding to the non-breach 0.29 PMF peak discharge was about 640.9 feet (Summary Input/Output Sheets, Sheet H). The maximum water surface level for the average breach conditions was about 642.6 (Summary Input/Output Sheets, Sheet M). The increase in water surface elevation due to dam failure was 1.7 feet, with the breach water surface above the damage level of the homes. (The homes affected by breach outflows would also be flooded by the 0.29 PMF even without embankment failure.)

The consequences of dam failure, however, can be better envisioned if not only the increase in the height of the floodwave is considered, but also the great increase in the momentum of the larger and probably swifter moving volume of water. Therefore, the failure of Trout Run Dam No. 4 would most probably lead to increased property damage and possibly increased loss of life in the downstream regions.

5.6 Spillway Adequacy.

As presented previously, under existing conditions Trout Run Dam No. 4 can accommodate only about 27 percent of the PMF (SDF) prior to embankment overtopping. Should a 0.29 PMF or larger event occur, the dam would be overtopped and possibly fail, endangering the residences and increasing the potential for loss of life in the downstream regions. Therefore, the spillway is considered to be seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in good condition. The facility is well maintained and no evidence of erosion or excess settlements were observed. Minor seepage was observed along the downstream embankment toe between the blowoff and approximately 150 feet left of the spillway. The downstream face was observed to be somewhat irregular exhibiting areas of minor bulging and slumping. Presently, neither condition is considered a threat to the structural stability of the embankment; nevertheless, both conditions should be specifically addressed in future inspections. Large trees along the downstream embankment toe hamper visual observation of both conditions and should be trimmed and/or removed.

b. Appurtenant Structures.

1. Spillway. The spillway appears to be structurally well designed and currently in good condition. The small seep observed through the channel floor of the emergency spillway should be sealed to prevent further concrete deterioration.

2. Outlet Works. The outlet works are reportedly functional. Concrete deterioration associated with the control tower is considered minor at this time.

6.2 Design and Construction Techniques.

No information is available that details the methods of design and/or construction.

6.3 Past Performance.

According to available correspondence and discussions with representatives of the owner, the facility has performed satisfactorily since construction in 1894. Damage to the spillway system was incurred during the floods of 1972 and 1975 and has been corrected.

6.4 Seismic Stability

The dam is located within Seismic Zone No. 1 and, thus

possibly subject to minor earthquake induced dynamic forces. As the embankment appears statically stable it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection suggests the facility is in good condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possibly loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 27 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased downstream damage and potential for loss of life. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

Deficiencies noted by the inspection team included slumping and bulging of the downstream embankment rock face, minor seepage along the downstream embankment toe, a deteriorating control tower structure and no emergency warning system in effect.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. Additional investigations are considered necessary and are listed in Section 7.2 below.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Develop a formal emergency warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

b. Remove the masonry blocks located atop the spillway and adjacent the wingwall and seal all cracks in the spillway channel floor.

c. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams and take remedial measures deemed necessary to make the facility hydraulically adequate.

d. Develop formal manuals of operation and maintenance to ensure the continued proper care of the facility.

e. Remove and/or trim the trees in the area immediately beyond the downstream embankment toe to provide an unobstructed view of the facility.

f. Specifically address in all future inspections the bulging and slumping of the downstream embankment face and seepage along the downstream embankment toe noting any significant changes.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Trout Run Dam No. 4 STATE Pennsylvania COUNTY Northumberland

NDI # PA — 00512 PENNDER # 49-5

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 6 November 1979 WEATHER Clear; cool TEMPERATURE 52 @ 3:00 p.m.

POOL ELEVATION AT TIME OF INSPECTION 878.6 M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B. M. Mihalcin	Roaring Creek Water Company	
D. L. Bonk	Harry Sacona (superintendent)	
D. J. Spaeder		

RECORDED BY B. M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00512
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Downstream slope is very irregular due to apparent movement of the hand-placed rock face. Some local bulging was observed along the toe.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Irregular downstream face is probably due to the steepness of the slope. Does not appear critical.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical - good. Horizontal - good.
RIPRAP FAILURES	None observed. Original riprap has apparently been covered with topsoil and light vegetation, and small diameter (2- to 3-inch) crushed stone. Functioning adequately with no evidence of erosion observed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00512
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Area immediately downstream of embankment toe is heavily overgrown with large trees up to about 6 inches in diameter.
ANY NOTICEABLE SEEPAGE	None through downstream embankment face. Minor seepage is evident across the downstream embankment toe between the spillway and blowoff outlet. Seepage was not measured in that it was not concentrated in any one particular area.
STAFF GAGE AND RECORDER	Water level marks (relative datum) are painted on control tower.
DRAINS	None observed.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00512
INTAKE STRUCTURE	Control tower in fair to good condition with some cracking of masonry and minor concrete deterioration exhibited. Steel and wood plank access bridge is in good condition.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	16-inch diameter cast iron pipe blowoff.
OUTLET STRUCTURE	None. The blowoff conduit discharges at the downstream toe to the left of the control tower.
OUTLET CHANNEL	Conduit discharges at base of downstream embankment toe and combines with natural stream approximately 50 feet below the dam. Rock-lined natural stream channel.
GATE(S) AND OPERATIONAL EQUIPMENT	Two valves in control tower are operated yearly. Accessibile by ladder within control tower. Valve on blowoff was not operated in the presence of the inspection team.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA. 00512
TYPE AND CONDITION	Two-stage concrete chute channel in good condition located at the right abutment. Minor concrete cracking was observed across the channel floor immediately downstream of the overflow weir. Slight leakage was observed through the cracks.
APPROACH CHANNEL	Rock- and concrete- lined channel. Unobstructed.
SPILLWAY CHANNEL AND SIDEWALLS	Spillway sidewalls in good condition. The concrete channel exhibits several cracks through which seepage is emanating. The spillway was renovated in 1977-78. Cracks should be sealed.
STILLING BASIN PLUNGE POOL	Rock-lined plunge pool in good condition.
DISCHARGE CHANNEL	Trapezoidal-shaped channel cut into natural ground, partially rock-lined, and in good condition.
BRIDGE AND PIERS EMERGENCY GATES	None.

SERVICE SPILLWAY

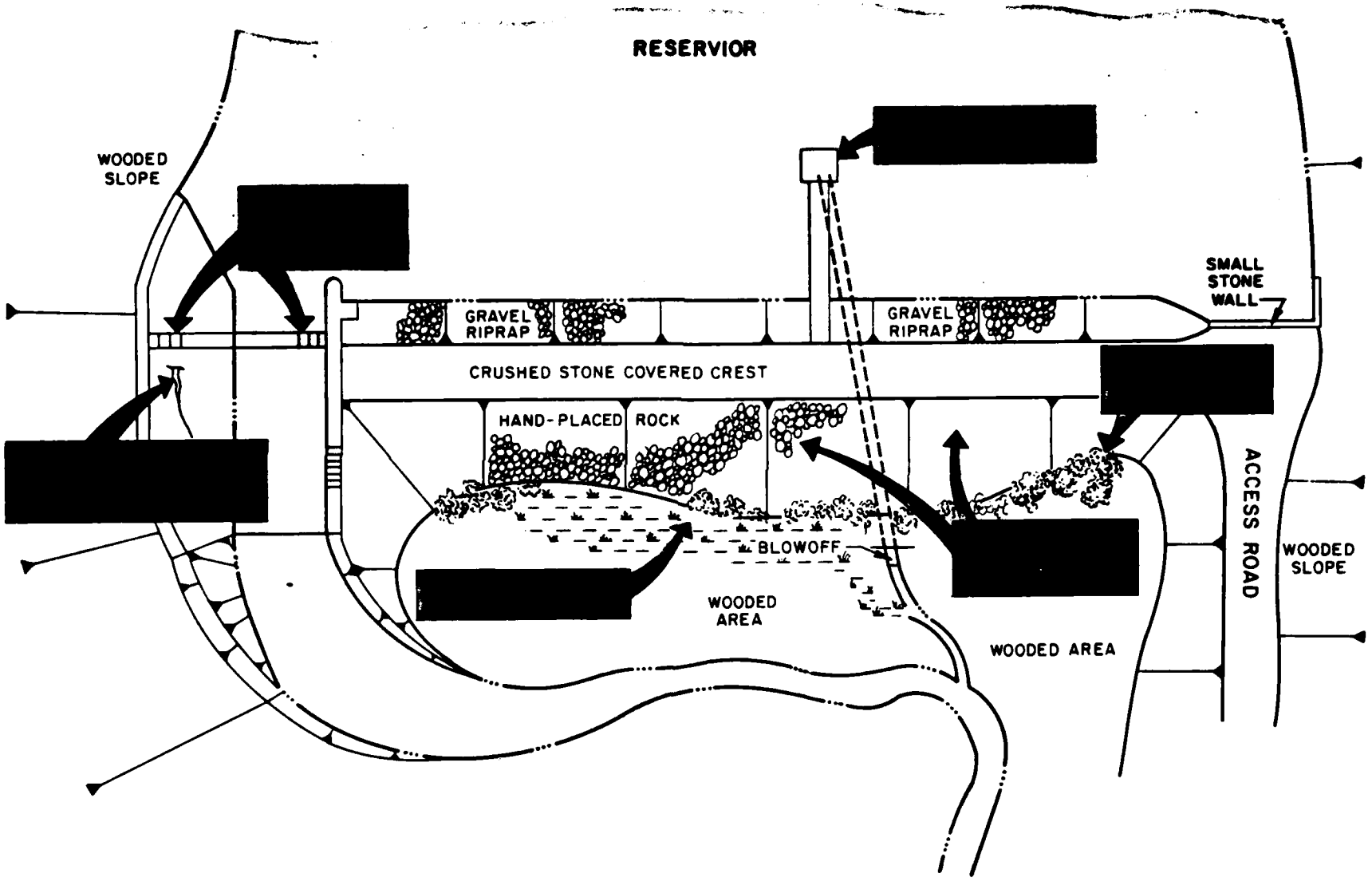
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00512
TYPE AND CONDITION	See sheet 4 of 8.
APPROACH CHANNEL	N/A.
OUTLET STRUCTURE	N/A.
DISCHARGE CHANNEL	N/A.

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00512
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	Rain gage located atop roof of owner's office in downtown Shamokin, Pennsylvania.

RESERVOIR AREA AND DOWNSTREAM CHANNEL

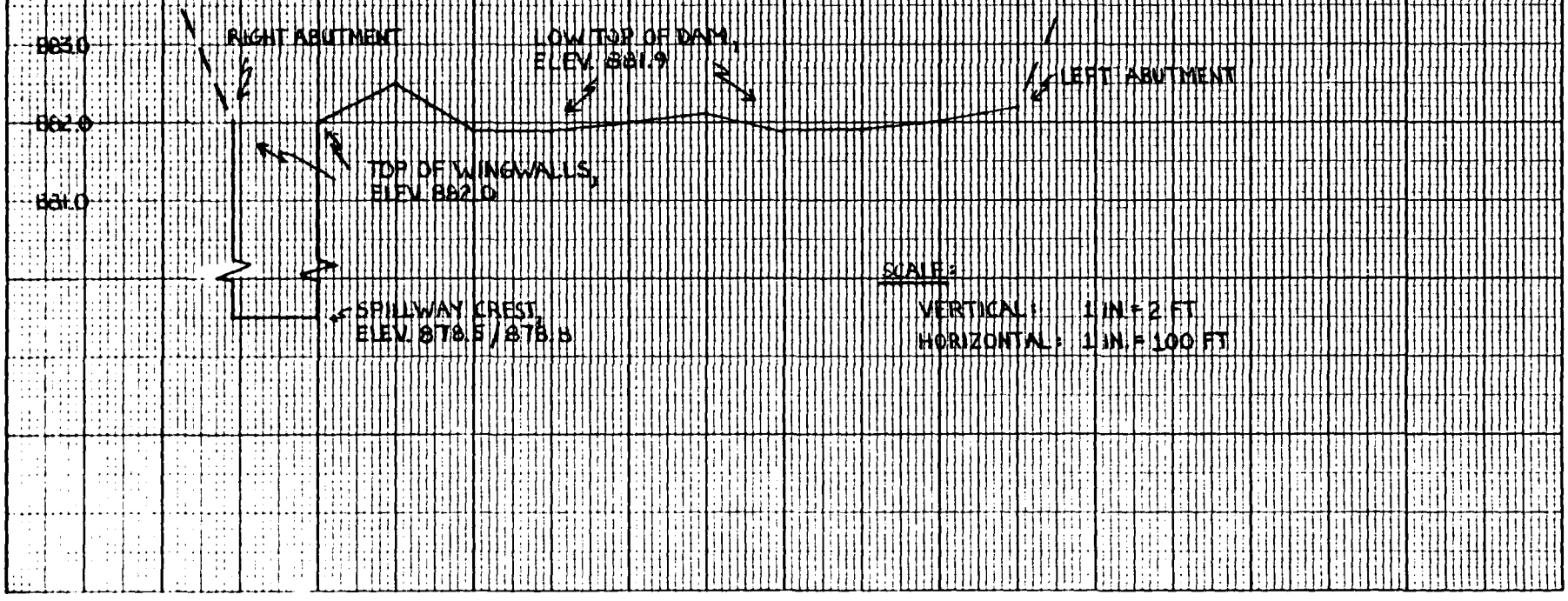
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00512
SLOPES: RESERVOIR	Moderate to steep wooded slopes.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Trout Run cuts through a steep, narrow, forested valley with steep confining slopes. The stream converges with Shamokin Creek approximately 1.3 miles downstream of the embankment.
SLOPES: CHANNEL VALLEY	Channel - steep. Valley - steep and heavily forested.
APPROXIMATE NUMBER OF HOMES AND POPULATION	The left bank of Shamokin Creek, opposite the inlet of Trout Run, is heavily developed with both industrial and residential structures. Several hundred people reside and/or work in this area. Substantial property damage and loss of life possibly could be the result of an embankment breach.



TROUT RUN DAM NO. 4
GENERAL PLAN - FIELD INSPECTION NOTES

TROUT RUN DAM NO. 4

PROFILE OF DAM CREST
FROM FIELD SURVEY



APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Trout Run Dam No. 4

ITEM	REMARKS NDI# PA - 00512
PERSONS INTERVIEWED AND TITLE	Roaring Creek Water Company Harry Sacona - Superintendent
REGIONAL VICINITY MAP	See Appendix E, Figure 1, (U.S.G.S. 7.5 minute topographic quadrangle, Shamokin, Pennsylvania).
CONSTRUCTION HISTORY	Constructed in 1882. Enlarged to present capacity in 1894. No construction records available. Good historical review from 1915 in PennDER files. See Section 1.2.g.
AVAILABLE DRAWINGS	Several drawings dated 1894 and 1915 available from both the owner and PennDER files. Drawing of last spillway renovation dated 1977 is also available from the owner. See Appendix E, Figures 2, 3, 4, and 5.
TYPICAL DAM SECTIONS	See Appendix E, Figure 5.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Appendix E, Figure 5. Not available. Not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA-00512
SPILLWAY: PLAN SECTION DETAILS	See Appendix E, Figures 3 and 4.	
OPERATING EQUIP- MENT PLANS AND DETAILS	Not available.	
DESIGN REPORTS	Not available.	
GEOLOGY REPORTS	Not available.	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	Not available.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	Not available.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA-00512
BORROW SOURCES	Not known.	
POST CONSTRUCTION DAM SURVEYS	Sediment survey only (see below).	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Middle Atlantic States Engineering Company of Fairless Hills, Pennsylvania performed a sediment survey in 1974. Data not available.	
HIGH POOL RECORDS	A cursory review of available records indicates the largest flood to date occurred on June 22 and 23, 1972 when daily rainfall measured 7.73 and 5.54 inches, respectively.	
MONITORING SYSTEMS	Estimate of water level made daily from paint markings on exterior of control tower. Normal pool at 21. feet (relative datum).	
MODIFICATIONS	Original facility built in 1882 and enlarged to present capacity in 1894. Spillway modified in 1920 and renovated in 1978.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00512
PRIOR ACCIDENTS OR FAILURES	Spillway walls failed during June 1972 flood. Further damage to spillway resulted from flood in fall of 1975. Dam reportedly has never been overtopped.
MAINTENANCE: RECORDS MANUAL	No formal records or manual.
OPERATION: RECORDS MANUAL	No formal records or manual.
OPERATIONAL PROCEDURES	Self regulating.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	Two security guards patrol 6 water company dams during daylight. Gates along access roads are locked at night. No formal warning system in effect.
MISCELLANEOUS	Downstream dams shown on old topographic maps were breached during 1960's.

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00512
PENNDER ID # 49-5

SIZE OF DRAINAGE AREA: 1.9 square miles

ELEVATION TOP NORMAL POOL: 878.5 STORAGE CAPACITY: 108 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 881.9 STORAGE CAPACITY: 115 acre-feet

SPILLWAY DATA

CREST ELEVATION: 878.5 (service), 878.8 (emergency)

TYPE: Two-staged, uncontrolled, service-emergency spillway

CREST LENGTH: 30.4 feet (service), 24.5 (emergency)

CHANNEL LENGTH: 42 feet

SPILLOVER LOCATION: Right abutment

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 16-inch diameter C.I.P. blowoff and supply lines

LOCATION: Approximate center of embankment

ENTRANCE INVERTS: 853.5 (blowoff; estimated zero storage elevation)

EXIT INVERTS: 851.7 (blowoff)

EMERGENCY DRAWDOWN FACILITIES: 16-inch diameter C.I.P. blowoff

HYDROMETEOROLOGICAL GAGES

TYPE: Rain gage

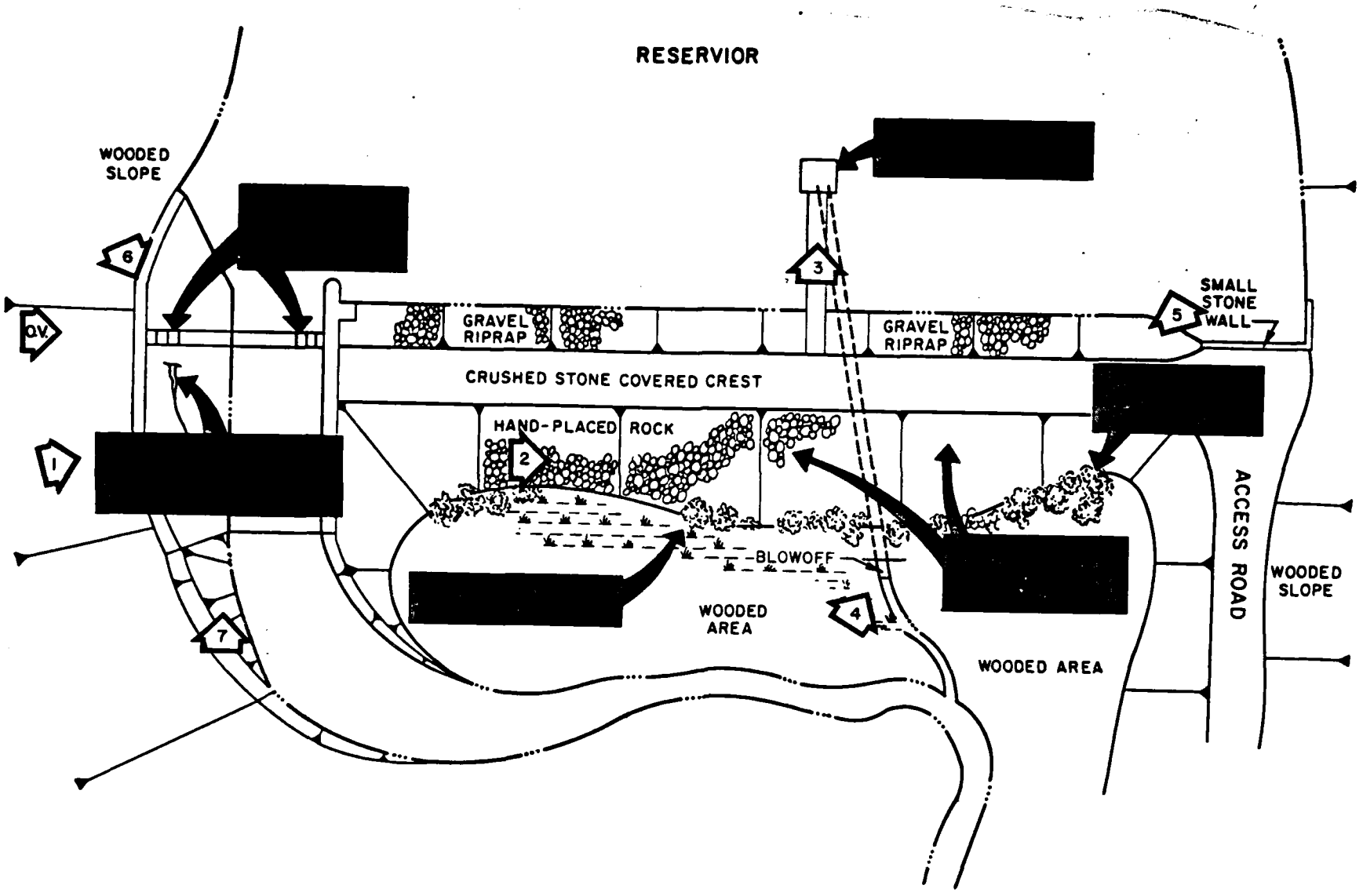
LOCATION: Atop roof of owner's main office, downtown Shamokin

RECORDS: Date back to circa 1880

MAXIMUM NON-DAMAGING DISCHARGE: June 22 and 23, 1972

APPENDIX C

PHOTOGRAPHS



TROUT RUN DAM NO. 4
PHOTOGRAPH KEY MAP

PHOTOGRAPH 1 View of the discharge end of the spillway and downstream face of the embankment as seen from the right abutment.

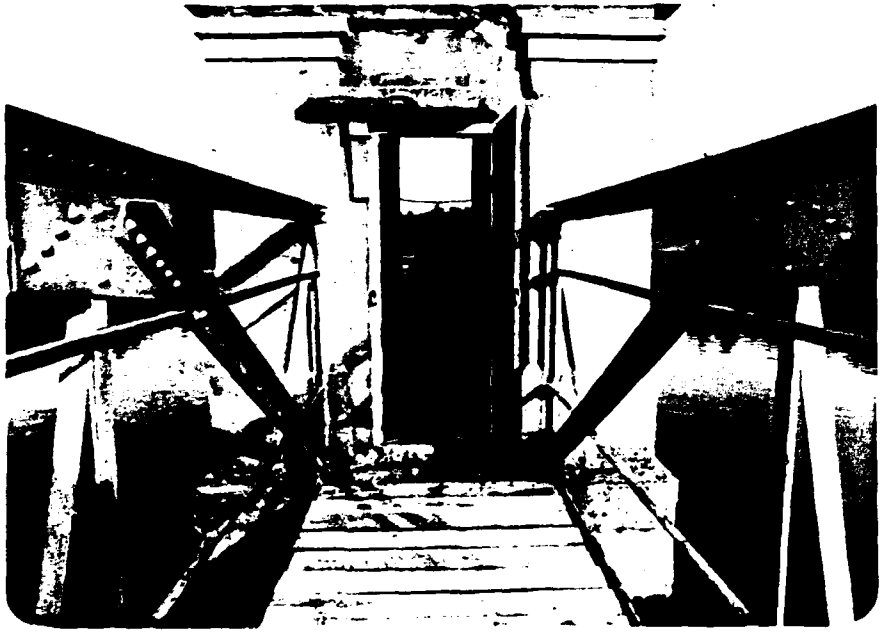
PHOTOGRAPH 2 View of the hand-placed, sandstone slope protection covering the irregular downstream embankment face.

PHOTOGRAPH 3 View of the concrete control tower that houses the gate valves for the outlet works.

PHOTOGRAPH 4 View of the discharge end of the 16-inch diameter blowoff conduit.

1

2



3

4

PHOTOGRAPH 5 View of the reservoir impounded by Trout Run Dam No. 4 as seen from the embankment crest.

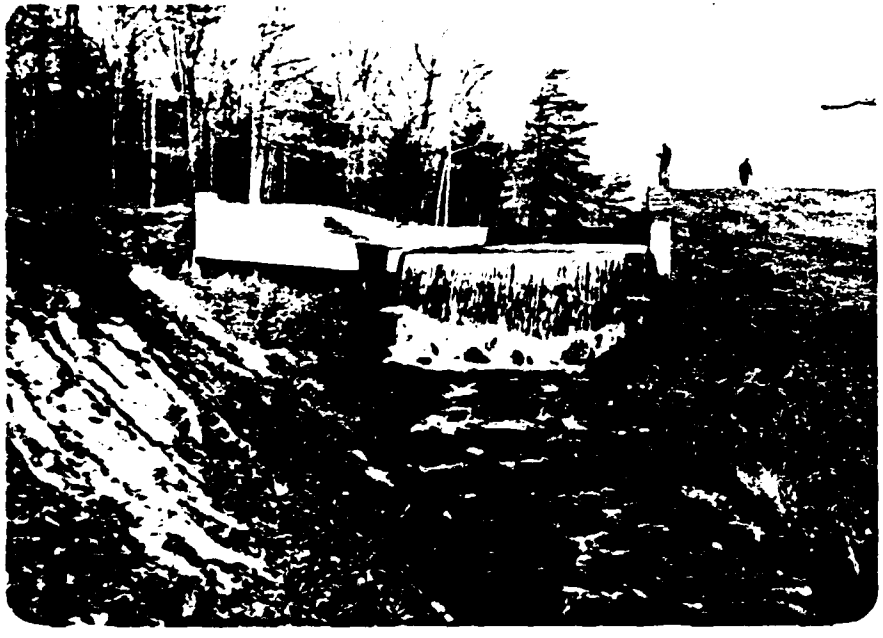
PHOTOGRAPH 6 View, looking downstream, of the spillway structure. Note the masonry blocks placed at the corners of the overflow weir adjacent the wingwalls.

PHOTOGRAPH 7 View, looking upstream, of the two-stage spillway structure.

PHOTOGRAPH 8 View of Trout Run near its confluence with Shamokin Creek approximately 1.3 miles downstream of the embankment.

5

6



7

8

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: TROUT RUN DAM NO. 4

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	TROUT RUN DAM NO. 4		
DRAINAGE AREA (SQUARE MILES)	1.9		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-		
ADJUSTMENT OF PMF FOR DRAINAGE AREA & LOCATION (%) (1)			
6 HOURS	119		
12 HOURS	128		
24 HOURS	137		
48 HOURS	144		
72 HOURS	146		
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	[illegible]		
C_p (3)	[illegible]		
C_t (3)	1.65		
L (MILES) (4)	[illegible]		
L_{ca} (MILES) (4)	[illegible]		
$T_L = C_t (L \cdot L_{ca})^{0.3}$ (HOURS)	3.24		
SPILLWAY DATA			
CREST LENGTH (FEET)	50.0		
FREEBOARD (FEET)	3.4		

(1) HYDROMETEOROLOGICAL REPORT 40, U.S. WEATHER BUREAU, 1965.

(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).

(3) SNYDER COEFFICIENTS

(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE.
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

(5) [illegible] CREST LENGTH OF TWO-STAGE SERVICE-EMERGENCY SPILLWAY.

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM #4

BY DJS DATE 11-15-79 PROJ. NO. 79-303-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 1 OF 20

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DAM STATISTICS

- HEIGHT OF DAM ≈ 30 FEET (FIELD MEASURED)
- NORMAL POOL STORAGE CAPACITY ≈ 35.3×10^6 GALLONS ≈ 108 ACRE-FT (SEE NOTE 1)
- MAXIMUM POOL STORAGE CAPACITY ≈ 155 AC-FT (AT LOW TOP OF DAM) (SHEET 4)
- DRAINAGE AREA ≈ 1.9 SQUARE MILES (PLANIMETERED ON USGS TOPO QUAD, JHAMOKIN, PA)
- ELEVATION OF TOP OF DAM (DESIGN) ≈ 882
- ELEVATION OF TOP OF DAM (FIELD) ≈ 881.9 (FIELD NOTES)
- NORMAL POOL ELEVATION ≈ 878.5 (SHEET 3)
- UPSTREAM INLET INVERT ≈ 853.5 (ESTIMATED ELEVATION BASED ON ZERO STORAGE POOL; SEE SHEET 3)
- DOWNSTREAM OUTLET INVERT (FIELD) ≈ 851.7 (FIELD NOTES)
- STREAMBED @ DAM CENTERLINE ≈ 852 (ESTIMATED FROM AVAILABLE DATA)

NOTE 1: TAKEN FROM "REPORT UPON THE NO. 4 DAM OF THE ROARING CREEK WATER COMPANY, ON TROUT RUN, COAL TOWNSHIP, NORTHUMBERLAND COUNTY, PA."; DATED MARCH 31, 1915; CONTAINED IN RENDER FILE.

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM #4

BY DJS DATE 11-15-79 PROJ. NO. 79-203-512
CHKD. BY DLB DATE 12-18-79 SHEET NO. 2 OF 30

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DAM CLASSIFICATION

DAM SIZE : SMALL (REF. 1, TABLE 1)

HAZARD CLASSIFICATION: HIGH (FIELD OBSERVATION)

REQUIRED SDF : ½ PMF to PMF (REFERENCE 1, TABLE 3)

HYDROGRAPH PARAMETERS

- LENGTH OF LONGEST WATERCOURSE : $L \approx 1.9$ MILES

- LENGTH OF LONGEST WATERCOURSE FROM DAM TO A POINT OPPOSITE BASIN CENTROID : $L_{CA} \approx 1.0$ MILE

{ MEASURED ON USGS TOPO: CHAMOKIN QUADRANGLE }

$C_t \approx 1.85$
$C_p \approx 0.50$

(SUPPLIED BY COE, ZONE 13, SUSQUEHANNA RIVER BASIN)

t_p = SNYDER'S STANDARD LAG = $C_t (L \times L_{CA})^{0.3}$
$\approx 1.85 (1.9 \times 1.0)^{0.3}$
≈ 2.24 HOURS

(NOTE: HYDROGRAPH VALUES USED HERE ARE DEFINED IN REFERENCE 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH")

RESERVOIR SURFACE AREAS

- SURFACE AREA (SA) AT NORMAL POOL ELEVATION (979.5) ≈ 18 ACRES (SEE NOTE 1)

- SA @ ELEV 990.0 ≈ 35 ACRES
- SA @ ELEV 993.0 ≈ 42 ACRES

{ PLANIMETERED ON USGS TOPO MAP: CHAMOKIN, PA }

PROJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-20-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 3 OF 20

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RESERVOIR VOLUMES BELOW NORMAL POOL:

— THE RESERVOIR CAPACITIES AT ELEVATIONS LESS THAN THAT OF NORMAL POOL ARE GIVEN ON FIGURE 2. (ON THE DRAWING, THE "100-FOOT" CONTOUR CORRESPONDS TO NORMAL POOL ELEVATION, 878.5.)

RESERVOIR ELEVATION (FT)	CAPACITY	
	MILLION GALLONS	ACRE-FT
863.5	1.48	4.5
868.5	6.44	19.7
873.5	17.90	54.8
878.5 (NORMAL POOL)	35.29	108.0

— RESERVOIR ELEVATION AT ZERO STORAGE:
- FROM FIGURE 2, THE ZERO STORAGE ELEVATION IS APPROXIMATELY 25 FEET BELOW THE NORMAL POOL ELEVATION, OR AT 853.5.

RESERVOIR VOLUMES ABOVE NORMAL POOL:

- BETWEEN NORMAL POOL ELEVATION AND ELEVATION 900.0, IT IS ASSUMED THAT THE MODIFIED PRISMOIDAL RELATIONSHIP ADEQUATELY MODELS THE RELATIONSHIP BETWEEN SURFACE AREA AND STORAGE: (SEE 4, p. 15)

$$\Delta V_{1-2} = h/3 \left(A_1 + A_2 + \sqrt{A_1 \times A_2}\right)$$

WHERE ΔV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 + 2, IN ACRE-FT
h = ELEVATION$_1$ − ELEVATION$_2$, IN FEET
A_1 = SURFACE AREA (SA) AT ELEVATION$_1$, IN ACRES
A_2 = SA AT ELEVATION$_2$, IN ACRES

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 9

BY DJS DATE 11-30-79 PROJ. NO. [illegible]

CHKD. BY DLB DATE 12-18-79 SHEET NO. 4 OF 20

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ALSO, $A_i = A_o + \left(\frac{\Delta SA}{\Delta H} \times H\right)$

WHERE A_i = SA AT ELEVATION i, IN FEET

A_o = SA AT $ELEV_o$ (NORMAL POOL, = 873.5)

$\frac{\Delta SA}{\Delta H}$ = RATE OF RESERVOIR AREA INCREASE PER FOOT RISE IN ELEVATION

- BETWEEN NORMAL POOL AND ELEVATION 900,

$\frac{\Delta SA}{\Delta H} = \frac{(35-12)}{(900-873.5)} = 1.07$ AC-FT/FT

$H = ELEV_i - ELEV_o = ELEV_i - 873.5$

ELEVATION - STORAGE RELATIONSHIP:

ELEVATION (FT)	A_i (AC)	ΔV_{1-3} (AC-FT)	TOTAL VOLUME (AC-FT)	
853.5	—	—	0	*
863.5	—	—	5	*
868.5	—	—	20	*
873.5	—	—	55	*
(NORMAL) 878.5	12.0	—	138	*
879.0	12.5	6.1	114	
880.0	13.6	13.0	127	
881.0	14.7	14.1	141	
(EMERGENCY SPILLWAY CREST) 881.9	15.6	13.6	155	
882.0	15.7	1.6	156	
883.0	16.8	16.2	173	

ELEVATION (FT)	A_i (AC)	ΔV_{1-3} (AC-FT)	TOTAL VOLUME (AC-FT)
884.0	17.9	17.3	190
885.0	19.0	18.4	208
886.0	20.0	19.5	228
887.0	21.1	20.5	248
888.0	22.2	21.6	270
889.0	23.2	22.7	293
890.0	24.3	23.7	316
895.0	29.7	134.8	451
900.0	35.0	161.6	613

* APPROXIMATE STORAGE CAPACITIES BELOW NORMAL POOL ARE TAKEN FROM SHEET 3.

JECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-29-79 PROJ. NO. 79-307-513
CHKD. BY DLB DATE 12-18-79 SHEET NO. 5 OF 20

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PMP CALCULATIONS

- FROM REFERENCE 9, FIGURE 2, OBTAIN PMP VALUE FOR A BASIN OF DRAINAGE AREA 220 SQUARE MILES, FOR A DURATION OF 24 HOURS:

  PRECIP = 22.2 INCHES

- FROM REFERENCE 9, FIGURE 1, THE GEOGRAPHIC ADJUSTMENT FACTOR = 101 %

- AREA CORRECTION FACTOR (REF. 9):

DURATION (HRS):	6	12	24	48	72
FACTOR (%):	117.5	127.0	136.0	142.5	145.0

- TOTAL CORRECTION FACTOR, = 1.01 × AREA CORRECTION FACTOR:

DURATION (HRS):	6	12	24	48	72
FACTOR (%):	119	128	137	144	146

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR A DRAINAGE AREA 1.9 SQUARE MILES IS 0.50 (REF 4, p. 48)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DTS DATE 11-15-79 PROJ. NO. 79-223-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 6 OF 20

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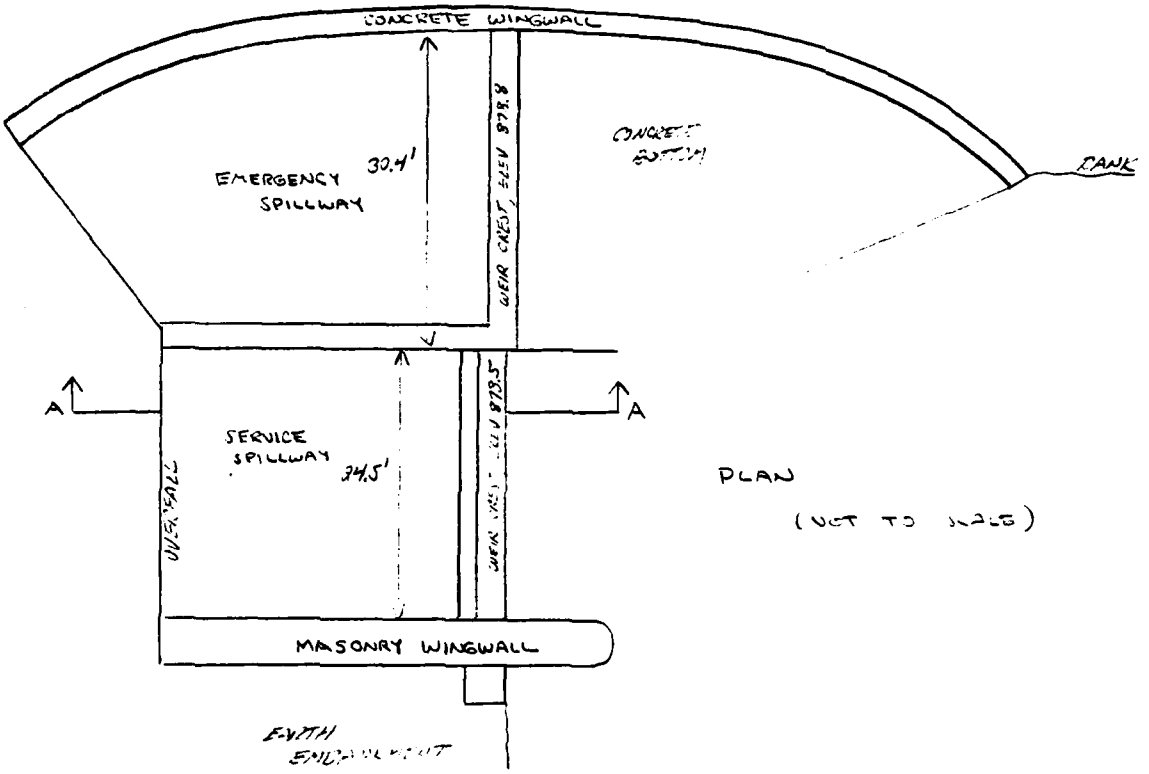
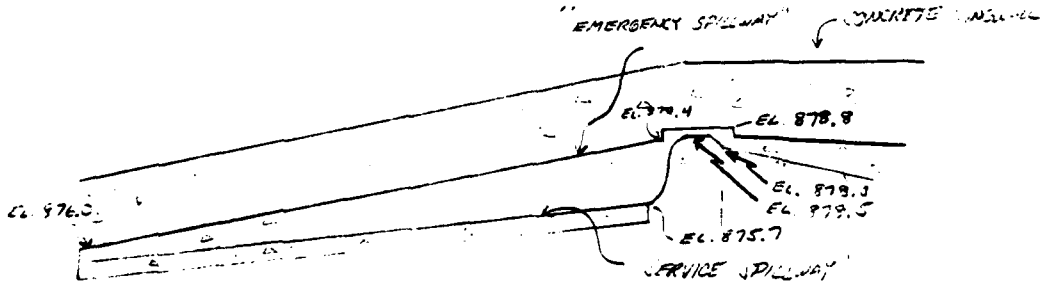
SPILLWAY CAPACITY



PLAN
(NOT TO SCALE)



SECTION A-A:
SPILLWAY PROFILE (NOT TO SCALE)
(LOOKING [illegible])

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 9

BY DJS DATE 11-19-79 PROJ. NO. [illegible]

CHKD. BY DLB DATE 12-18-79 SHEET NO. 7 OF 20

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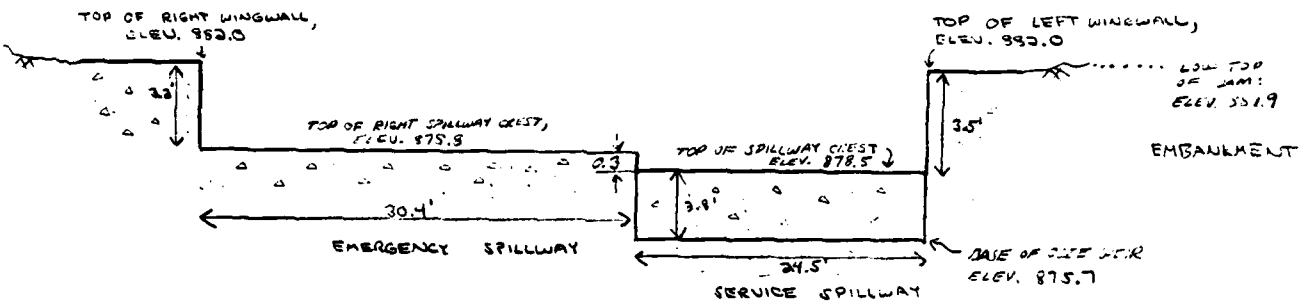
SPILLWAY CROSS-SECTION:



(SECTION LOOKING UPSTREAM)

- THE SPILLWAY IS A TWO-STAGE SERVICE-EMERGENCY TYPE CONSISTING OF A SERVICE SECTION WITH AN OGEE-LIKE OVERFLOW CREST AND AN EMERGENCY SECTION WITH A FLAT OVERFLOW CREST, AS SHOWN ABOVE.

- <u>CAPACITY OF "SERVICE SPILLWAY":</u>

  - DISCHARGE OVER THE OGEE-LIKE WEIR OF THE "SERVICE SPILLWAY" CAN BE ESTIMATED BY THE EQUATION

$$Q_w = CLH^{3/2} \qquad \text{(REF. 4, P. [illegible])}$$

WHERE Q_w = WEIR DISCHARGE (CFS)
L = LENGTH OF WEIR CREST = 24.5 FT
H = HEIGHT OF HYDRAULIC HEAD [illegible]
C = DISCHARGE COEFFICIENT

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-13-79 PROJ. NO. 79-803-513

CHKD. BY DLB DATE 12-18-79 SHEET NO. 8 OF 20

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- THE DESIGN HEAD (H_o) IS ASSUMED TO BE AT THE TOP OF THE WINGWALL, OR 3.5 FEET ABOVE THE SPILLWAY CREST. THE EXCESS DEPTH (P) IS APPROXIMATELY 2.5 FEET. CALCULATE THE DESIGN DISCHARGE COEFFICIENT:

  -FOR A VERTICAL-FACED OGEE CREST, WITH $\frac{P}{H_o} = \frac{2.5}{3.5} \approx 0.14$,

  $C \approx 3.47$

  (REF 4, p. 378, FIG. 344)

  - FOR AN OGEE-FACED CREST WITH SLOPING UPSTREAM FACE (WITH $\frac{P}{H_o} = 0.14$, AND ASSUMING A 45° SLOPING UPSTREAM FACE),

  $\frac{C_{INCLINED}}{C_{VERTICAL}}$ 1.04 (REF 4, p. 379 FIG. 355)

  $\therefore C_o = (1.04)(3.47) \approx 3.61$

- DOWNSTREAM HIGH EFFECTS AND TAILWATER EFFECTS ARE ASSUMED TO BE NEGLIGIBLE HERE, AND IT IS ASSUMED THAT THERE ARE NO APPROACH VELOCITY HEAD.

- AS THE HEAD ABOVE THE WEIR BECOMES SMALL, DISCHARGE IS REDUCED DISPROPORTIONATELY, DUE TO THE ROUGHNESS AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE WEIR. THUS, THE DISCHARGE COEFFICIENT (C) TAKES ON A LOWER VALUE THAN THAT OF DESIGN HEAD. CONVERSELY, AT HEADS HIGHER THAN THAT OF DESIGN THE DISCHARGE COEFFICIENTS WILL BE HIGHER THAN THAT OF DESIGN. THEREFORE, THE DESIGN DISCHARGE COEFFICIENT IS MODIFIED APPROPRIATELY, ACCORDING TO FIGURE 250, REFERENCE 4.

PROJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-30-79 PROJ. NO. 79-293-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 9 OF 20

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SERVICE SPILLWAY RATING TABLE:

	RESERVOIR ELEVATION (FT)	H (FT)	H/H_o	① C/C_o	② C	③ $Q = CLH^{3/2}$ (CFS)
	878.5	0	—	—	—	0
	879.0	0.5	0.14	1.83	3.10	30
	880.0	1.5	0.43	1.91	3.24	150
	881.0	2.5	0.71	0.96	3.47	340
(LOW TOP OF DAM)	881.9	3.4	0.97	0.99	3.57	550
(TOP OF WINGWALL)	882.0	3.5	1.00	1.00	3.61	580
	883.0	4.5	1.29	1.04	3.75	850
	884.0	5.5	1.57	1.07	3.86	1200
	885.0	6.5	1.86	1.07	3.86	1570
	886.0	7.5	2.14	1.07	3.86	1940
	887.0	8.5	2.43	1.07	3.86	2340
	888.0	9.5	2.71	1.07	3.86	2770
	889.0	10.5	3.00	1.07	3.86	3230
	890.0	11.5	3.29	1.07	3.86	3690

① FROM FIGURE 350, p. 378, REF. 4.

② $C = C_o (C/C_o)$

③ $L = 34.5$

CAPACITY OF EMERGENCY SPILLWAY:

THE EMERGENCY SPILLWAY CONSISTS OF A RECTANGULAR CHANNEL ON A STEEP SLOPE, WITH A SMALL RECTANGULAR-SHAPED FLAT-CRESTED WEIR. DISCHARGE WILL BE DESCRIBED BY THE EQUATION

$Q = CLH^{3/2}$ (REF 5, p. 5-37)

(Q, C, L, H, AS DEFINED ON SHEET 7)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-21-79 PROJ. NO. 79-207-210

CHKD. BY DLB DATE 12-18-79 SHEET NO. 10 OF 20

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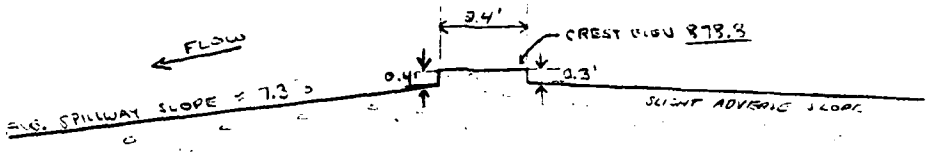

- FOR LOW FLOWS, THE DIMENSIONS OF THE SMALL WEIR INDICATE THAT IT WILL BEHAVE AS A BROAD-CRESTED WEIR WITH A DISCHARGE COEFFICIENT RANGING FROM ABOUT 2.5 TO [illegible]. AT HIGHER HEADS, THE WEIR WILL ACT AS THE CHANNEL CONTROL POINT WHERE CRITICAL FLOW OCCURS, DUE TO THE DOWNSTREAM STEEP SLOPE. IN THESE CASES, THE LIMITING VALUE ON THE DISCHARGE COEFFICIENT WILL BE 3.087. APPROACH LOSSES WILL BE NEGLIGIBLE HERE.

(REF 5, p. 5-201, 5-4)

EMERGENCY SPILLWAY RATING TABLE:

	RESERVOIR ELEVATION (FT)	H (FT)	① C	② Q (CFS)
	878.3	0	—	—
	879.0	0.2	2.49	10
	880.0	1.2	2.66	110
	881.0	2.2	2.84	280
(TOP OF DAM)	881.9	3.1	2.99	510
(TOP OF PARAPET)	882.2	3.4	3.04	540
	883.0	4.2	3.07	810
	884.0	5.2	3.09	1110
	885.0	6.2	3.09	1450
	886.0	7.2	3.09	1810
	887.0	8.2	3.09	2210
	888.0	9.2	3.09	2650
	889.0	10.2	3.09	3060
	890.0	11.2	3.09	3530

① AT HEADS OF 30 FEET AND LOWER, DISCHARGE COEFFICIENTS TAKEN FROM TABLE 5-7

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 1

BY DJS DATE 11-21-79 PROJ. NO. 79-307-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 11 OF 20

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REFERENCE 5, p. 5-40. AT HEADS GREATER THAN 1.5, TABLE 5-3 GIVES C-VALUES WHICH ARE HIGHER THAN WOULD BE EXPECTED FOR THE EXISTING WEIR (SINCE THE HEIGHT OF THIS WEIR IS LOW). SO IT IS ASSUMED THAT CRITICAL FLOW OCCURS AT THAT POINT, RESULTING IN A C-VALUE OF 3.087 ≈ 3.09 (CRITICAL FLOW, RECTANGULAR CHANNEL).

② $Q = CLH^{3/2}$, $L = 30.4$ FT.

TOTAL SPILLWAY RATING TABLE : $Q_{\text{SPILLWAY TOTAL}} = Q_{\text{SERVICE}} - Q_{\text{EMERGENCY}}$

RESERVOIR ELEV (FT)	Q_{SERVICE} (CFS)	$Q_{\text{EMERGENCY}}$ (CFS)	$Q_{\text{TOTAL SPILLWAY}}$ (CFS)
878.5	0	0	0
879.0	30	10	40
880.0	150	110	260
881.0	340	290	630
(LOW TOP OF DAM) 881.1	550	510	1060
(TOP OF PARAPET WALL) 882.0	580	540	1120
883.0	880	810	1690
884.0	1330	1110	2440
885.0	1570	1450	3020
886.0	1940	1810	3750
887.0	3240	3310	4550
888.0	3770	3620	5390
889.0	3990	3060	6980
890.0	3690	3520	7210

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-23-79 PROJ. NO. 79-232-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 12 OF 20

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EMBANKMENT RATING CURVE

- ASSUME THAT THE EMBANKMENT ACTS ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPED. THUS, THE DISCHARGE WILL BE DEFINED BY THE RELATIONSHIP:

$$Q = CLH^{3/2} \qquad \text{(REF. 5, p. 5-20)}$$

WHERE Q = DISCHARGE (CFS)

L = LENGTH OF EMBANKMENT OVERTOPPED (FT)

H = HEAD ON THE WEIR; HERE IT IS THE AVERAGE "FLOW-AREA" WEIGHTED HEAD ABOVE THE CREST, USING THE LOW TOP OF DAM AS A DATUM. (FEET)

C = COEFFICIENT OF DISCHARGE, DEPENDENT ON THE HEAD AND THE WEIR BREADTH.

- FIND THE LENGTH OF EMBANKMENT SUBMERGED FOR VARIOUS RESERVOIR ELEVATIONS:

	RESERVOIR ELEV. (FT)	APPROXIMATE LENGTH OF EMBANKMENT (FT)	
(LOW TOP OF DAM)	881.7	100	
	882.0	200	
	882.2	400	
	882.5	460	
	883.0	470	
	885.0	530	
	890.0	630	(FROM FIELD NOTES + DWG. 701)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 11-20-79 PROJ. NO. 79-220-512

CHKD. BY DLB DATE 12-18-79 SHEET NO. 13 OF 20

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- ASSUME INCREMENTAL DISCHARGES OVER THE EMBANKMENT ARE APPROXIMATELY TRAPEZOIDAL IN CROSS-SECTION. THEN ANY INCREMENTAL AREA OF FLOW $\simeq H_i [(L_1 + L_2)/2]$, WHERE L_1 = LENGTH AT LOWER ELEVATION, L_2 = LENGTH AT HIGHER ELEVATION, H_i = DIFFERENCE IN ELEVATIONS. THUS, THE TOTAL AVERAGE "FLOW-AREA WEIGHTED" HEAD, $H_{w.T}$, = TOTAL FLOW AREA / L_2.

RESERVOIR ELEVATION (FT)	L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	① INCREMENTAL FLOW AREA, A_i (FT^2)	TOTAL FLOW AREA, ΣA_T (FT^2)	② WEIGHTED HEAD, $H_{w.T}$ (FT)	③ $H_{w.T}/J$	④ C	⑤ Q (CFS)
881.9	100	—	0	—	—	—	—	—	—
883.0	100	230	2.1	16.5	16.5	0.37	2.31	2.99	10
883.2	230	400	0.2	63	80	0.2	2.32	2.97	110
883.5	400	460	0.3	129	209	0.45	2.33	3.31	400
885.0	460	470	2.5	233	442	2.94	2.07	3.33	1200
885.0	470	590	2.0	990	1432	2.75	2.31	3.38	7000
890.0	590	630	5.0	2875	4307	6.84	2.53	3.39	34,800

① $A_i = L_i \left(\frac{L_1 + L_2}{2}\right)$

② $H_{w.T} = A_T / L_2$

③ J = LENGTH OF CREST = 13 FT

④ $C = f(H, J)$; VALUES TAKEN FROM REF 2, P. 5.34

⑤ $Q = C L_2 H_{w.T}^{3/2}$

SUBJECT Dam Safety Inspection

TROUT RUN DAM NO. 4

BY DTC DATE 11-21-79 PROJ. NO. 79-303-513

CHKD. BY DLB DATE 12-18-79 SHEET NO. 14 OF 20

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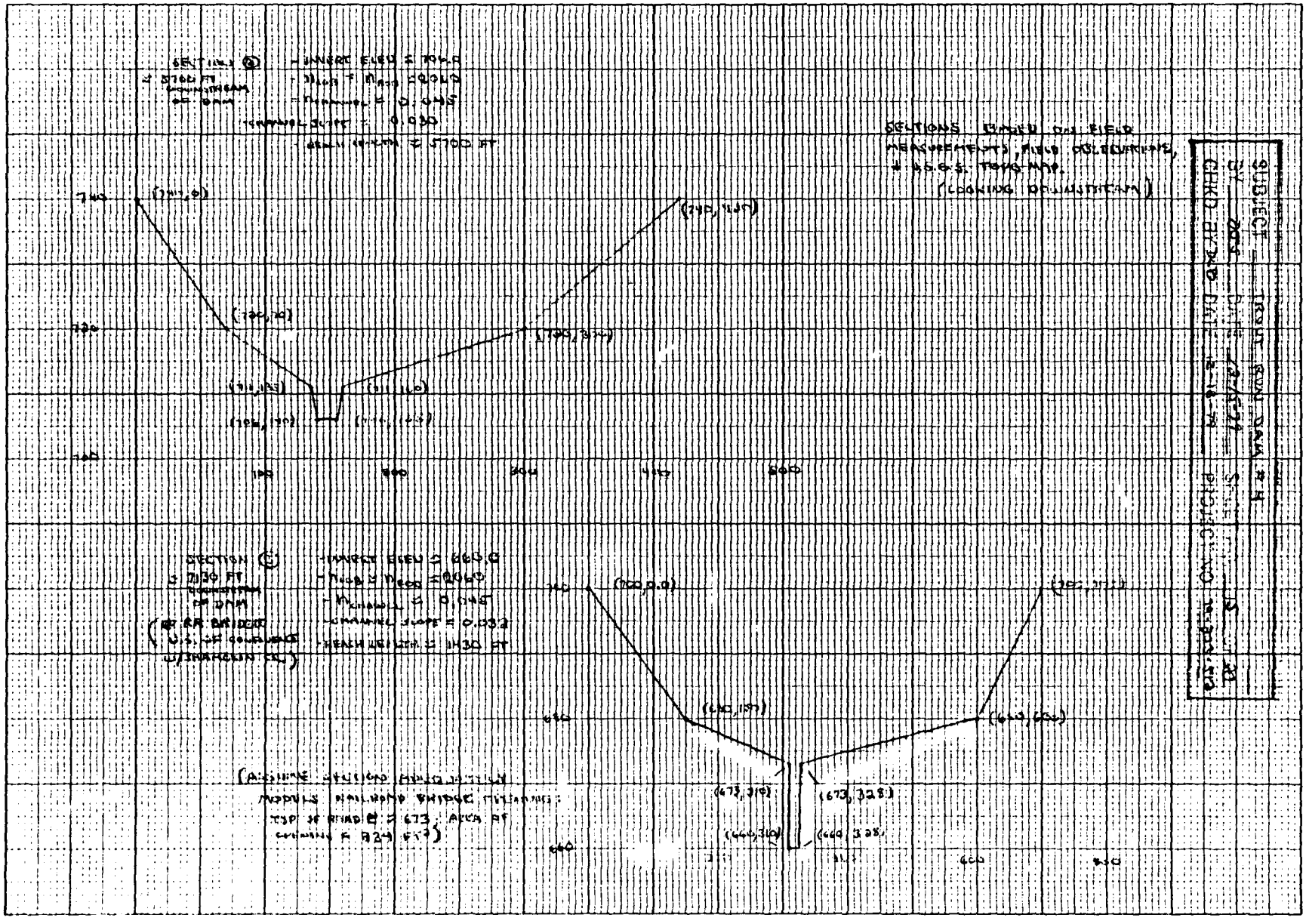
TOTAL FACILITY RATING TABLE

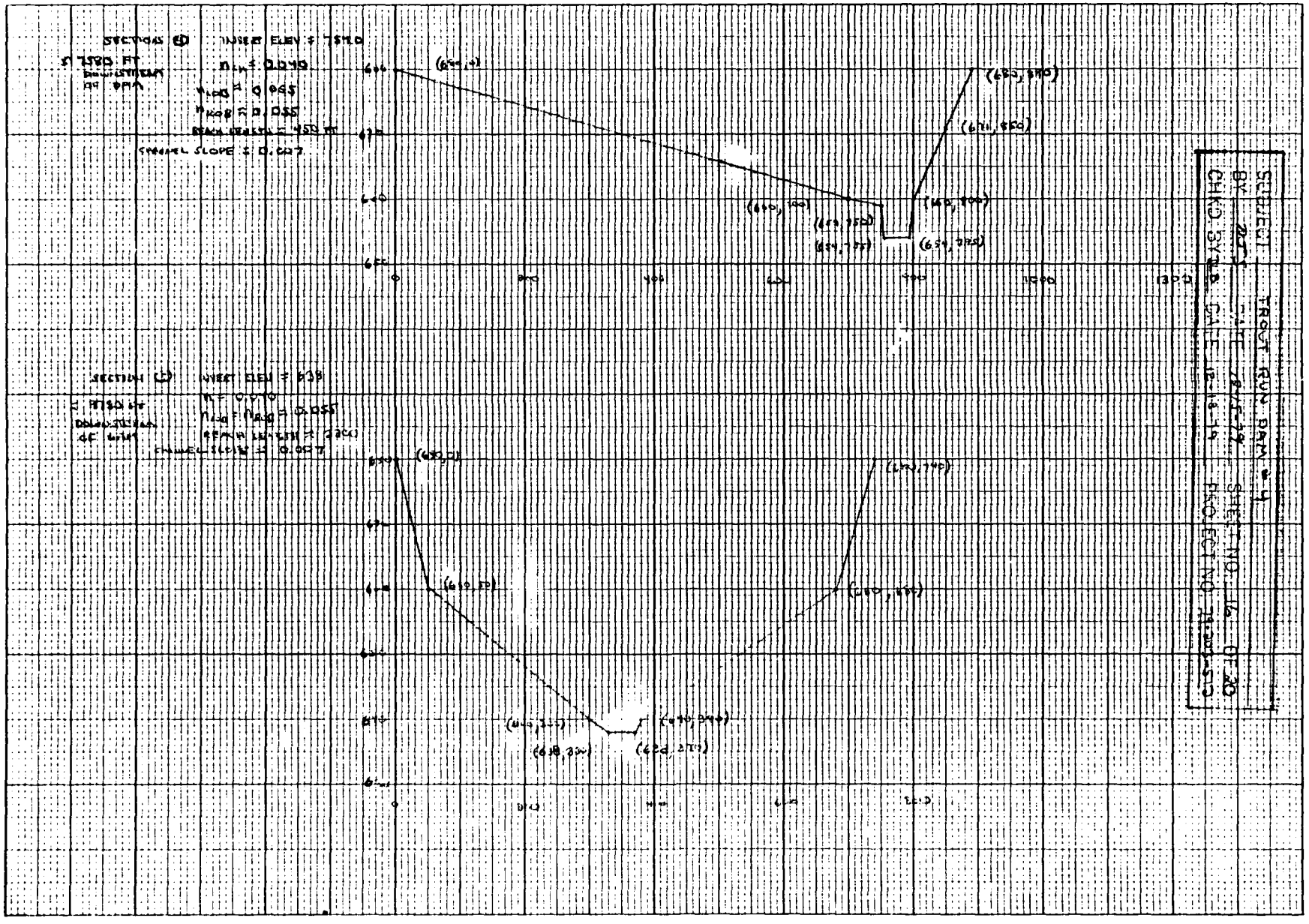
$Q_{TOTAL} = Q_{TOTAL\ SPILLWAY} + Q_{EMBANKMENT}$

	RESERVOIR ELEVATION (FT)	$Q_{SPILLWAY}$ (CFS)	$Q_{EMBANKMENT}$ (CFS)	Q_{TOTAL} (CFS)
(NORMAL POOL)	878.5	0	—	0
	879.0	40	—	40
	880.0	360	—	360
	881.0	620	—	620
(TOP OF DAM)	881.9	1060	0	1060
	882.0	1130	10	1130
	882.2	1330 *	110	1240
	882.5	1410 *	430	1840
	883.0	1690	1300	2990
	884.0	2330	3400 **	5730
	885.0	3080	7300	10380
	886.0	3750	11,300 **	14,950
	887.0	4550	16,000 **	20,550
	888.0	5390	21,200 **	26,590
	889.0	6380	27,500 **	33,880
	890.0	7310	34,900	42,200

* LINEAR INTERPOLATION

** LOG-LOG INTERPOLATION




SUBJECT TROUT RUN DAM #4
BY DATE SHEET NO. 16 OF 20
CHKD BY DATE PROJECT NO.

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 12-12-79 PROJ. NO. 79-302-512

CHKD. BY DLB DATE 12-26-79 SHEET NO. 17 OF 30

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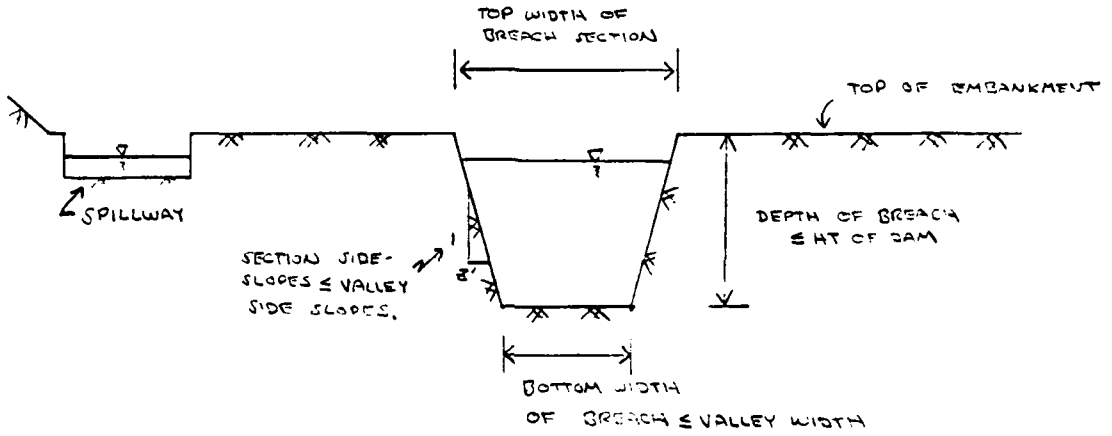
BREACH ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1 BREACHING ANALYSIS INPUT:

(BREACHING BEGINS WHEN RESERVOIR LEVEL REACHES LOW TOP OF DAM ELEVATION: 881.7)

PLAN	BREACH BOTTOM WIDTH (FT)	MAX BREACH DEPTH (FT)	SECTION SIDE SLOPES	BREACH TIME (HR)	WSEL AT START OF FAILURE (FT)
① MINIMUM BREACH SECTION, MINIMUM FAIL TIME.	0	28	½H:1V	0.5	881.7
② MAXIMUM BREACH SECTION, MINIMUM FAIL TIME.	250	28	3H:1V	0.5	881.7
③ MINIMUM BREACH SECTION, MAXIMUM FAIL TIME.	0	53	½H:1V	4.0	881.7
④ MAXIMUM BREACH SECTION, MAXIMUM FAIL TIME.	250	28	3H:1V	4.0	881.7
⑤ AVERAGE POSSIBLE CONDITIONS.	70	28	1H:1V	2.0	881.7

PROJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DTS DATE 12-12-79 PROJ. NO. 79-252-512

CHKD. BY DLB DATE 12-26-79 SHEET NO. 18 OF 20

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- THE BREACH ASSUMPTIONS LISTED IN THE PREVIOUS SHEET ARE BASED ON THE SUGGESTED RANGES PROVIDED BY THE COE (BALTIMORE DISTRICT) AND ON THE PHYSICAL CONSTRAINTS OF THE DAM AND THE SURROUNDING TERRAIN:

  - DEPTH OF BREACH OPENING = 38 FT (ELEV DIFFERENCE BETWEEN TOP OF DAM AND LOW POINT OF RESERVOIR)
  - EMBANKMENT CREST LENGTH = 450 FT (BREACHABLE EMBANKMENT, FIELD MEASUREMENT)
  - VALLEY BOTTOM WIDTH : = 250 FT (FIELD OBSERVATION)
  - VALLEY SIDE SLOPES ADJACENT TO DAM :

    RIGHT SIDE : 8.0 H : 1.0 V

    LEFT SIDE : 3.0 H : 1.0 V

    (USGS TOPO : HANDOUT 5)

SUBJECT Dam Safety Inspection

Trout Run Dam No. 4

BY [illegible] DATE 12-18-79 PROJ. NO. 79-323-52

CHKD. BY DLB DATE 12-26-79 SHEET NO. 19 OF 20

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HEC-1 Dam Breaching Analysis Output:

Reservoir Data:

(Under 0.29 PMF Base Flow Conditions)

Plan Number *	Variable Breach Bottom Width (FT)	Actual Max Flow During Fail Time (CFS)	Corresponding Time of Flow (HR)	Interpolated or HEC-1 Routed Max Flow During Fail Time (CFS)	Corresponding Time of Flow (HR)	Actual Peak Flow Through Dam (CFS)	Corresponding Time of Flow (HR)	Time of Initial Breach (HR)
①	0	4158	42.17	4158	42.17	4158	42.17	41.67
②	250	8449	41.89	8385	41.83	8449	41.89	41.67
③	0	1492	45.25	1491	45.17	1492	45.25	41.67
④	250	2153	42.25	2151	42.33	2153	42.25	41.67
⑤	40	2965	42.50	2965	42.50	2965	42.50	41.67

* - [illegible]

SUBJECT Dam Safety Inspection — Trout Run Dam No. 4

BY JJS DATE 02-28-79 PROJ. NO. 79-302-52

CHKD. BY DLB DATE 12-26-79 SHEET NO. 30 OF 90

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DOWNSTREAM ROUTING DATA :

(UNDER 0.39 PMF BASE FLOW CONDITIONS)

PLAN (1) NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	OUTPUT @ SECTION 4, = 7580 FT D.S. OF DAM				OUTPUT @ SECTION 5, = 9780 FT D.S. OF DAM			
		PEAK FLOW (CFS)	CORRESPONDING WSEL (2) (FT)	WSEL w/o BREACH (3) (FT)	ELEV DIFF (4) (FT)	PEAK FLOW (CFS)	CORRESPONDING WSEL (2) (FT)	WSEL w/o BREACH (3) (FT)	ELEV DIFF (4) (FT)
①	0	3549	661.0	657.8	+3.2	3282	642.8	640.9	+1.9
②	350	5623	662.5	657.8	+4.7	4977	643.8	640.9	+2.9
③	0	1484	658.4	657.8	+0.6	1480	641.2	640.9	+0.3
④	250	2137	659.5	657.8	+1.7	2134	641.9	640.9	+1.0
⑤	10	2926	660.4	657.8	+2.6	2890	642.6	640.9	+1.7

(1) SEE SHEET 17.

(2) WATER SURFACE ELEVATIONS CORRESPONDING TO PEAK OUTFLOW ...
(SUMMARY INPUT/OUTPUT SHEETS, ... M.).

(3) PEAK FLOW AND WSEL IN MAIN CHANNEL, FOR THE PEAK 0.39 PMF AS INTERPOLATED FROM SHEET H, SUMMARY INPUT/OUTPUT ...

(4) ELEV DIFF = (CORRESPONDING WSEL) − (WSEL w/o BREACH).

SUBJECT Dam Safety Inspection

BY [illegible] DATE 12-27-79 PROJ. NO. 79-393-513

CHKD. BY DLR DATE 12-22-79 SHEET NO. A OF M

Trout Run Dam No. 4

OVERTOPPING ANALYSIS

DAM SAFETY INSPECTION
TROUT RUN DAM = 4 ***** OVERTOPPING ANALYSIS *****
10-MINUTE TIME STEP AND 48 HOUR STORM DURATION

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .20 .30 .40 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.90	0.00	1.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	119.00	128.00	137.00	144.00	0.00	0.00

INSPC COMPUTED BY THE PROGRAM IS .800

INITIAL & CONSTANT RAINFALL LOSS (C.O.E.)

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.24 CP= .50 NTA= 0

BASEFLOW PARAMETERS (C.O.E.)

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=14.35 AND R=18.28 INTERVALS

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PROJECT Dam Safety Inspection

Trout Run Dam No. 4

BY JSS DATE 12-21-79 PROJ. NO. 79-833-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. 5 OF M

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UNIT HYDROGRAPH END-OF-PERIOD ORDINATES, LAG = 2.26 HOURS, CP = 0.60, VOL = 0.99

5.	19.	40.	64.	91.	120.	151.	182.	211.	235.
254.	269.	278.	280.	273.	260.	246.	233.	220.	209.
198.	187.	177.	168.	159.	150.	142.	135.	128.	121.
114.	108.	102.	97.	92.	87	82.	78.	74.	70.
66.	63.	59.	56.	53.	50.	48.	45.	43.	40.
38.	36.	34.	32.	31.	29.	28.	26.	25.	23.
22.	21.	20.	19.	18.	17.	16.	15.	14.	14.
13.	12.	11.	11.	10.	10.	9.	9.	8.	8.
7.	7.	7.	6.	6.	6.	5.	5.	5.	5.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.57	23.25	2.32	154166.
										(650.)(	591.)(	59.)(	4365.49).

RESERVOIR INFLOW HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4100.	3092.	1062.	534.	153720.
CMS	116.	88.	30.	15.	4353.
INCHES		15.14	20.80	20.91	20.91
MM		384.51	528.34	531.01	531.01
AC-FT		1533.	2107.	2117.	2117.
THOUS CU M		1891.	2599.	2612.	2612.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	820.	618.	212.	107.	30744.
CMS	23.	18.	6.	3.	871.
INCHES		3.03	4.16	4.18	4.18
MM		76.90	105.67	106.20	106.20
AC-FT		307.	421.	423.	423.
THOUS CU M		378.	520.	522.	522.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1230.	928.	319.	160.	46116.
CMS	35.	26.	9.	5.	1306.
INCHES		4.54	6.24	6.27	6.27
MM		115.35	158.50	159.30	159.30
AC-FT		460.	632.	635.	635.
THOUS CU M		567.	780.	784.	784.

0.4 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1640.	1237.	425.	213.	61488.
CMS	46.	35.	12.	6.	1741.
INCHES		6.06	8.32	8.36	8.36
MM		153.80	211.33	212.40	212.40
AC-FT		613.	843.	847.	847.
THOUS CU M		756.	1039.	1045.	1045.

SUBJECT Dam Safety Inspection

Trout Run Dam No. 4

BY [illegible] DATE 12-21-79 PROJ. NO. 79-903-519

CHKD. BY DLB DATE 12-22-79 SHEET NO. 5 OF M

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		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
RESERVOIR	CFS	2050.	1546.	531.	267.	76860.	
INFLOW	CMS	58.	44.	15.	8.	2176.	
HYDROGRAPH	INCHES		7.57	10.40	10.45	10.45	0.5 PMF
	MM		192.25	264.17	265.50	265.50	
	AC-FT		767.	1053.	1059.	1059.	
	1000S CU M		946.	1299.	1306.	1306.	

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

JMAX	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

METR	NSTPS	LAG	AMSKK	X	TSK	STORA	ITSPRAT
1	0	0	0.000	0.000	0.000	100.	-1

STAGE	878.50	879.00	880.00	881.00	881.90	882.00	882.20	882.50	883.00
	885.00	886.00	887.00	888.00	889.00	890.00			
FLOW	0.00	40.00	200.00	620.00	1060.00	1130.00	1340.00	1830.00	2499.00
	10320.00	19230.00	28550.00	38590.00	49780.00	62033.00			
CAPACITY=	0.	5.	20.	55.	104.	114.	127.	141.	159.	155.
	173.	190.	208.	228.	248.	270.	293.	316.		
ELEVATION=	878.	879.	880.	881.	882.	883.	884.	885.	886.	887.
	888.	889.	890.						

CREL	SPWID	COQW	EXPW	ELEVI	COQL	CAREA	EXPL
878.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
891.3	0.0	0.0	0.

PEAK OUTFLOW IS 4098. AT TIME 42.00 HOURS

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
RESERVOIR	CFS	4098.	3091.	1041.	523.	150502.	
OUTFLOW	CMS	116.	88.	29.	15.	4262.	
HYDROGRAPH	INCHES		15.13	20.38	20.47	20.47	PMF
	MM		384.35	517.72	519.89	519.89	
	AC-FT		1533.	2064.	2073.	2073.	
	1000S CU M		1890.	2546.	2557.	2557.	

SUBJECT Dam Safety Inspection

BY JJS DATE 12-21-79 PROJ. NO. 79-303-S12

CHKD. BY DLR DATE 12-22-79 SHEET NO. D OF M

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Trout Run Dam No. 4

RESERVOIR OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 801. AT TIME 42.33 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	801.	613.	204.	103.	29546.
CMS	23.	17.	6.	3.	837.
INCHES		3.00	4.00	4.02	4.02
MM		76.19	101.64	102.07	102.07
AC-FT		304.	405.	407.	407.
THOUS CU M		375.	500.	502.	502.

0.2 PMF

PEAK OUTFLOW IS 1220. AT TIME 42.17 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1220.	921.	308.	155.	44601.
CMS	35.	26.	9.	4.	1263.
INCHES		4.51	6.04	6.07	6.07
MM		114.49	153.42	154.07	154.07
AC-FT		457.	612.	614.	614.
THOUS CU M		563.	755.	758.	758.

0.3 PMF

PEAK OUTFLOW IS 1636. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1636.	1230.	413.	207.	59686.
CMS	46.	35.	12.	6.	1690.
INCHES		6.02	8.08	8.12	8.12
MM		152.94	205.31	206.18	206.18
AC-FT		610.	819.	822.	822.
THOUS CU M		752.	1010.	1014.	1014.

0.4 PMF

PEAK OUTFLOW IS 2049. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2049.	1538.	517.	260.	74773.
CMS	58.	44.	15.	7.	2117.
INCHES		7.53	10.13	10.17	10.17
MM		191.31	257.21	258.29	258.29
AC-FT		764.	1026.	1030.	1030.
THOUS CU M		941.	1265.	1270.	1270.

0.5 PMF

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HYDROGRAPH ROUTING

ROUTE FROM DAM TO SECTION 2, 5700 FT D.S. OF DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
102	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

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NORMAL DEPTH CHANNEL ROUTING

QR(1)	QR(2)	QR(3)	ELRVT	ELMAX	RLNTH	SEL
.0000	.0450	.0600	700.0	740.0	5700.	.03000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 740.00 70.00 720.00 135.00 711.00 140.00 706.00 155.00 706.00
160.00 711.00 300.00 720.00 420.00 740.00

STORAGE	0.00	3.93	8.70	14.49	27.08	49.22	80.90	122.12	172.81
	289.89	354.40	422.89	495.36	571.81	652.25	736.66	825.06	917.43
OUTFLOW	0.00	225.54	729.65	1513.25	2917.23	5294.41	8992.31	14306.95	21648.57
	43571.09	57446.50	73294.29	91151.54	111061.74	133072.49	157234.05	183598.41	212218.67
STAGE	700.00	707.29	709.58	711.37	713.16	714.95	716.74	718.53	720.32
	724.89	725.68	727.47	729.26	731.05	732.84	734.63	736.42	738.21
FLOW	0.00	225.54	729.65	1513.25	2917.23	5294.41	8992.31	14306.95	21648.57
	43571.09	57446.50	73294.29	91151.54	111061.74	133072.49	157234.05	183598.41	212218.67

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 2 TO 3, 7130 FT D.S. OF DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
203	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPAP		LSTR
0.0	0.000	0.00	1	1	0	0		0
	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QR(1)	QR(2)	QR(3)	ELRVT	ELMAX	RLNTH	SEL
.0000	.0450	.0600	660.0	700.0	1430.	.03200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 700.00 150.00 680.00 310.00 673.00 310.00 660.00 328.00 660.00
126.00 673.00 600.00 680.00 700.00 700.00

SUBJECT Dam Safety Inspection
Trout Run Dam No. 4
BY DJC DATE 12-21-79 PROJ. NO. 79-203-513
CHKD. BY DLB DATE 12-22-79 SHEET NO. F OF M

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STORAGE	0.00	1.24	2.49	3.73	4.98	6.22	7.46	11.76	24.91
	77.23	110.15	144.89	181.45	219.82	260.02	302.03	345.86	391.51
OUTFLOW	0.00	320.48	906.28	1614.12	2392.64	3216.35	4070.87	5580.70	9627.57
	33080.26	55238.58	82811.08	115622.95	153598.83	196720.08	245003.59	298489.79	357235.47
STAGE	660.00	662.11	664.21	666.32	668.42	670.53	672.63	674.74	676.84
	681.05	683.16	685.26	687.37	689.47	691.58	693.68	695.79	697.89
FLOW	0.00	320.48	906.28	1614.12	2392.64	3216.35	4070.87	5580.70	9627.57
	33080.26	55238.58	82811.08	115622.95	153598.83	196720.08	245003.59	298489.79	357235.47

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 3 TO SECTION 4; 7580 FT D.S. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
304	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0550	.0400	.0550	654.0	680.0	450.	.00700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 680.00 700.00 660.00 750.00 659.00 755.00 654.00 795.00 654.00
800.00 660.00 850.00 671.00 890.00 680.00

STORAGE	0.00	.58	1.20	1.86	2.60	4.09	6.30	9.39	13.18
	23.07	29.16	36.02	43.64	52.03	61.18	71.09	81.76	93.20
OUTFLOW	0.00	208.64	659.43	1293.79	2110.92	3322.80	5109.38	7588.53	10885.28
	20381.66	26789.20	34433.03	43407.48	53800.48	65696.55	79179.26	94329.92	111227.89
STAGE	654.00	655.37	656.74	658.11	659.47	660.84	662.21	663.58	664.95
	667.68	669.05	670.42	671.79	673.16	674.53	675.89	677.26	678.63
FLOW	0.00	208.64	659.43	1293.79	2110.92	3322.80	5109.38	7588.53	10885.28
	20381.66	26789.20	34433.03	43407.48	53800.48	65696.55	79179.26	94329.92	111227.89

SUBJECT Dam Safety Inspection

BY JJS DATE 12-21-79 PROJ. NO. 79-803-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. 6 OF M

Trout Run Dam No 4

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 4 TO SECTION 5: 9780 FT D.S. OF DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
405	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSAK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QR(1)	QR(2)	QR(3)	ELEVI	ELMAX	RLNTH	SEL
.0550	.0400	.0550	648.0	680.0	2200.	.00700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 680.00 30.00 660.00 300.00 640.00 330.00 638.00 370.00 638.00
380.00 640.00 680.00 660.00 740.00 680.00

STORAGE	0.00	6.94	19.91	39.67	66.22	99.55	139.66	186.57	240.26
	368.00	439.08	511.51	585.30	660.45	736.96	814.83	894.05	974.63
OUTFLOW	0.00	608.94	2632.69	6278.25	11842.95	19606.40	29833.34	42776.00	58675.90
	100428.47	129756.95	162396.04	198235.17	237189.18	279191.34	324186.84	372139.61	423010.21
STAGE	638.00	640.21	642.42	644.63	646.84	649.05	651.26	653.47	655.68
	660.11	662.32	664.53	666.74	668.95	671.16	673.37	675.58	677.79
FLOW	0.00	608.94	2632.69	6278.25	11842.95	19606.40	29833.34	42776.00	58675.90
	100428.47	129756.95	162396.04	198235.17	237189.18	279191.34	324186.84	372139.61	423010.21

SUBJECT Dam Safety Inspection

BY JJS DATE 12-27-79 PROJ. NO. 79-203-512

CHKD. BY DAB DATE 12-27-79 SHEET NO. 11 OF 21

Trout Run Dam No. 4

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SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	878.50	878.50	881.90
STORAGE	108.	108.	155.
OUTFLOW	0.	0.	1060.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	881.37	0.00	147.	801.	0.00	42.33	0.00
.27 *	881.90	—	155	1060	—	—	—
.30	882.09	.19	157.	1220.	2.00	42.17	0.00
.40	882.38	.48	162.	1636.	3.83	42.00	0.00
.50	882.59	.69	166.	2049.	5.00	42.00	0.00
1.00	883.40	1.50	180.	4098.	8.67	42.00	0.00

* INTERPOLATED VALUES; OVERTOPPING OCCURS AT APPROXIMATELY 0.27 PMF.

PLAN 1 STATION 102

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	799.	709.7	42.50
.30	1218.	710.7	42.17
.40	1633.	711.5	42.17
.50	2043.	712.0	42.17
1.00	4087.	714.0	42.17

SECTION @ 5700 FT D.S. FROM DAM

PLAN 1 STATION 203

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	800.	663.8	42.50
.30	1218.	665.1	42.33
.40	1632.	666.4	42.17
.50	2044.	667.5	42.17
1.00	4087.	672.7	42.17

SECTION @ 7130 FT D.S. FROM DAM

PLAN 1 STATION 304

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	800.	657.0	42.50
.30	1218.	657.9	42.33
.40	1632.	658.7	42.17
.50	2044.	659.4	42.17
1.00	4087.	661.4	42.17

SECTION @ 7580 FT D.S FROM DAM

PLAN 1 STATION 405

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	799.	640.4	42.50
.30	1218.	640.7	42.33
.40	1630.	641.3	42.33
.50	2041.	641.8	42.17
1.00	4084.	643.4	42.17

SECTION @ 9780 FT D.S. FROM DAM,

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. I OF M

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BREACHING ANALYSIS

(INPUT DATA IS SAME AS THAT FOR OVERTOPPING ANALYSIS WITH THE ADDITION OF THE BREACH DATA GIVEN HERE.)

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DAM SAFETY INSPECTION
FROUI RUN DAM = 4 ***** BREACHING ANALYSIS *****
10-MINUTE TIME STEP AND 48 HOUR STORM DURATION

                    JOB SPECIFICATION
 NU   NHR  NMIN  IDAY   IHR  IMIN  METRC   IPLT  IPNT  NSTAN
 249    0    10     0    0     0      0      0     0      0
                    JOPER  NWT  LROPT  TRACE
                         5    0      0      0

 MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 5 MRTIO= 1 LRTIO= 1

 RTIOS=   .29

**********  **********  **********  **********  **********

                HYDROGRAPH ROUTING

 ROUTE THROUGH RESERVOIR

                                    DAM DATA
                                 COPEL  CWID  EXPD  DAMWID
                                 881.9   0.0   0.0     0.

                              DAM BREACH DATA
                          HRWID     Z   ELBM  TRAIL    WSEL  FAILBL
                             0.    .50  853.50   .50  878.50  881.90

                          STATION   101, PLAN 1, RATIO 1

PLAN (1)

BEGIN DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS    4158. AT TIME  42.17 HOURS

                                    DAM BREACH DATA
                          HRWID     Z   ELBM  TRAIL    WSEL  FAILBL
                           250.    3.00  853.50   .50  878.50  881.90

                          STATION   101, PLAN 2, RATIO 1

PLAN (2)

BEGIN DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS    4442. AT TIME  41.83 HOURS
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PROJECT Dam Safety Inspection

Trout Run Dam No. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-303-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. J OF M

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PLAN ③

DAM BREACH DATA

BRWID	Z	ELBM	TRAIL	WSEL FAILED
0.	.50	853.50	4.00	878.50 881.90

STATION 101, PLAN 3, RATIO 1

MAXIMUM DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 1992. AT TIME 45.25 HOURS

PLAN ④

DAM BREACH DATA

BRWID	Z	ELBM	TRAIL	WSEL FAILED
250.	3.00	853.50	4.00	878.50 881.90

STATION 101, PLAN 4, RATIO 1

MAXIMUM DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 2153. AT TIME 42.25 HOURS

PLAN ⑤

DAM BREACH DATA

BRWID	Z	ELBM	TRAIL	WSEL FAILED
90.	1.00	853.50	4.00	878.50 881.90

STATION 101, PLAN 5, RATIO 1

MAXIMUM DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 2063. AT TIME 42.50 HOURS

PROJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-303-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. K OF M

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PLAN 5

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	- COMPUTED BREACH HYDROGRAPH (CFS)	= ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
41.667	0.000	1114.	1114.	0.	0.	0.
41.708	.042	1302.	1257.	45.	45.	0.
41.750	.083	1489.	1434.	56.	101.	0.
41.792	.125	1677.	1650.	27.	128.	0.
41.833	.167	1865.	1865.	0.	128.	0.
41.875	.208	2023.	2060.	-37.	91.	0.
41.917	.250	2181.	2231.	-50.	41.	0.
41.958	.292	2339.	2376.	-37.	4.	0.
42.000	.333	2497.	2501.	-4.	0.	0.
42.042	.375	2575.	2594.	-20.	-15.	-0.
42.083	.417	2653.	2671.	-19.	-35.	-0.
42.125	.458	2731.	2746.	-16.	-51.	-0.
42.167	.500	2810.	2810.	0.	-51.	-0.
42.208	.542	2844.	2865.	-22.	-73.	-0.
42.250	.583	2878.	2912.	-34.	-106.	-0.
42.292	.625	2912.	2932.	-20.	-126.	-0.
42.333	.667	2947.	2947.	0.	-126.	-0.
42.375	.708	2951.	2956.	-5.	-131.	-0.
42.417	.750	2956.	2961.	-6.	-136.	-0.
42.458	.792	2960.	2964.	-4.	-140.	-0.
42.500	.833	2965.	2965.	0.	-140.	-0.
42.542	.875	2874.	2964.	-90.	-230.	-1.
42.583	.917	2783.	2962.	-179.	-409.	-1.
42.625	.958	2692.	2764.	-72.	-481.	-1.
42.667	1.000	2601.	2601.	0.	-481.	-1.
42.708	1.042	2540.	2498.	42.	-440.	-1.
42.750	1.083	2479.	2431.	47.	-392.	-1.
42.792	1.125	2418.	2387.	31.	-362.	-1.
42.833	1.167	2357.	2354.	0.	-362.	-1.
42.875	1.208	2181.	2335.	-154.	-515.	-1.
42.917	1.250	2005.	2069.	-63.	-579.	-2.
42.958	1.292	1830.	1764.	65.	-513.	-2.
43.000	1.333	1654.	1654.	0.	-513.	-2.
43.042	1.375	1632.	1609.	23.	-490.	-2.
43.083	1.417	1609.	1587.	22.	-468.	-2.
43.125	1.458	1586.	1574.	13.	-455.	-2.
43.167	1.500	1564.	1564.	0.	-455.	-2.
43.208	1.542	1445.	1150.	296.	-160.	-2.
43.250	1.583	1327.	1096.	231.	71.	0.
43.292	1.625	1209.	1106.	103.	174.	1.
43.333	1.667	1090.	1090.	0.	174.	1.
43.375	1.708	1082.	1084.	-3.	171.	1.
43.417	1.750	1073.	1073.	-1.	170.	1.
43.458	1.792	1065.	1065.	-1.	170.	1.
43.500	1.833	1056.	1056.	0.	170.	1.
43.542	1.875	1047.	1047.	-0.	169.	1.
43.583	1.917	1037.	1038.	-0.	169.	1.
43.625	1.958	1028.	1028.	-0.	169.	1.
43.667	2.000	1018.	1018.	0.	169.	1.

JECT DAM SAFETY INSPECTION

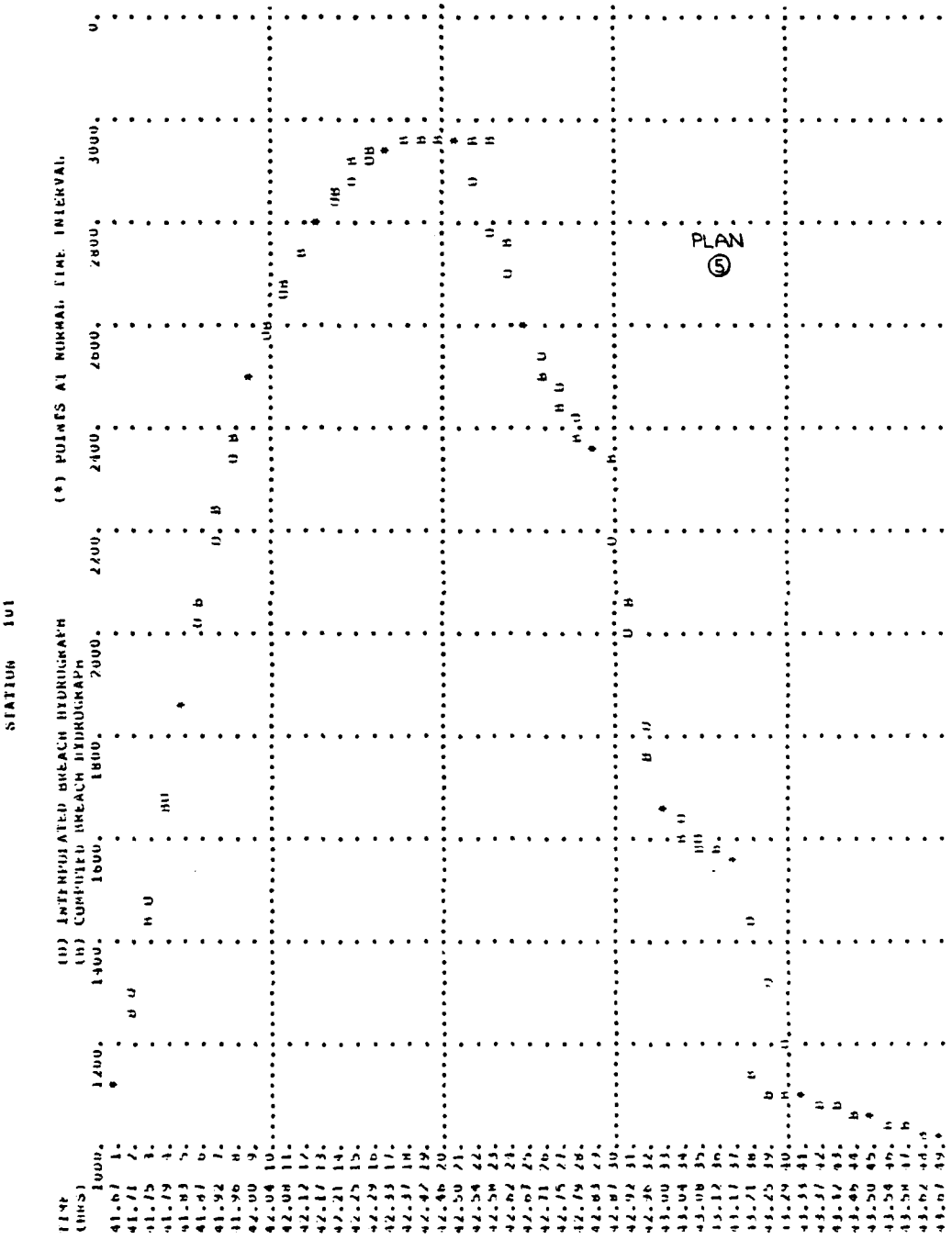
TROUT RUN DAM NO. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. L OF M

CONSULTANTS, INC.

Engineers • Geologists • Planners
Environmental Specialists



SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4

BY DJI DATE 12-21-79 PROJ. NO. 79-302-513

CHKD. BY DCB DATE 12-22-79 SHEET NO. M OF M

CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	878.50	878.50	881.90
STORAGE	108.	108.	155.
OUTFLOW	0.	0.	1060.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
①	.29	881.99	.09	156.	4158.	.34	42.17	41.67
②	.29	881.97	.07	156.	3449.	.19	41.89	41.67
③	.29	882.04	.14	157.	1492.	1.08	45.25	41.67
④	.29	881.97	.07	156.	2153.	.25	42.25	41.67
⑤	.29	881.97	.07	156.	2965.	.25	42.50	41.67

STATION 304

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
①	.29	3549.	661.0	42.33
②	.29	3023.	660.5	42.00
③	.29	1484.	658.4	45.17
④	.29	2137.	659.5	42.33
⑤	.29	2928.	660.4	42.50

SECTION 4 @ 7580 FT
D.S. FROM DAM
(@ 1ST GROUP OF HOMES)

STATION 405

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
①	0.29	3282	642.8	42.33
②	.29	4977.	643.8	42.17
③	.29	1480.	641.2	45.33
④	.29	2134.	641.9	42.50
⑤	.29	2890.	642.6	42.50

SECTION 5 @ 9780 FT
D.S. FROM DAM
(@ 2ND GROUP OF HOMES)

LIST OF REFERENCES

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2. "Unit Hydrograph Concepts and Calculations," by Corps of Engineers, Baltimore District (L-519).

3. "Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Duration of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, prepared by J. T. Riedel, J. F. Appleby and R. W. Schloemer, Hydrologic Service Division Hydrometeorological Section, U. S. Department of the Army, Corps of Engineers, Washington, D. C., April 1956.

4. Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, Washington, D. C., 1973.

5. Handbook of Hydraulic, H. W. King and E. F. Brater, McGraw-Hill, Inc., New York, 1963.

6. Standard Handbook for Civil Engineers, F. S. Merritt, McGraw-Hill, Inc., New York, 1968.

7. Open-Channel Hydraulics, V. T. Chow, McGraw-Hill, Inc., New York, 1959.

8. Weir Experiments, Coefficients, and Formulas, R. E. Horton, Water Supply and Irrigation Paper No. 200, Department of the Interior, United States Geological Survey, Washington, D. C., 1907.

9. "Probable Maximum Precipitation Susquehanna River Drainage Above Harrisburg, Pennsylvania," Hydrometeorological Report 40, prepared by H. V. Goodyear and J. T. Riedel, Hydrometeorological Branch Office of Hydrology, U. S. Weather Bureau, U. S. Department of Commerce, Washington, D. C., May 1965.

10. Flood Hydrograph Package (HEC-1) Dam Safety Version, Hydrologic Engineering Center, U. S. Army, Corps of Engineers, Davis, California, July 1978.

11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army, Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

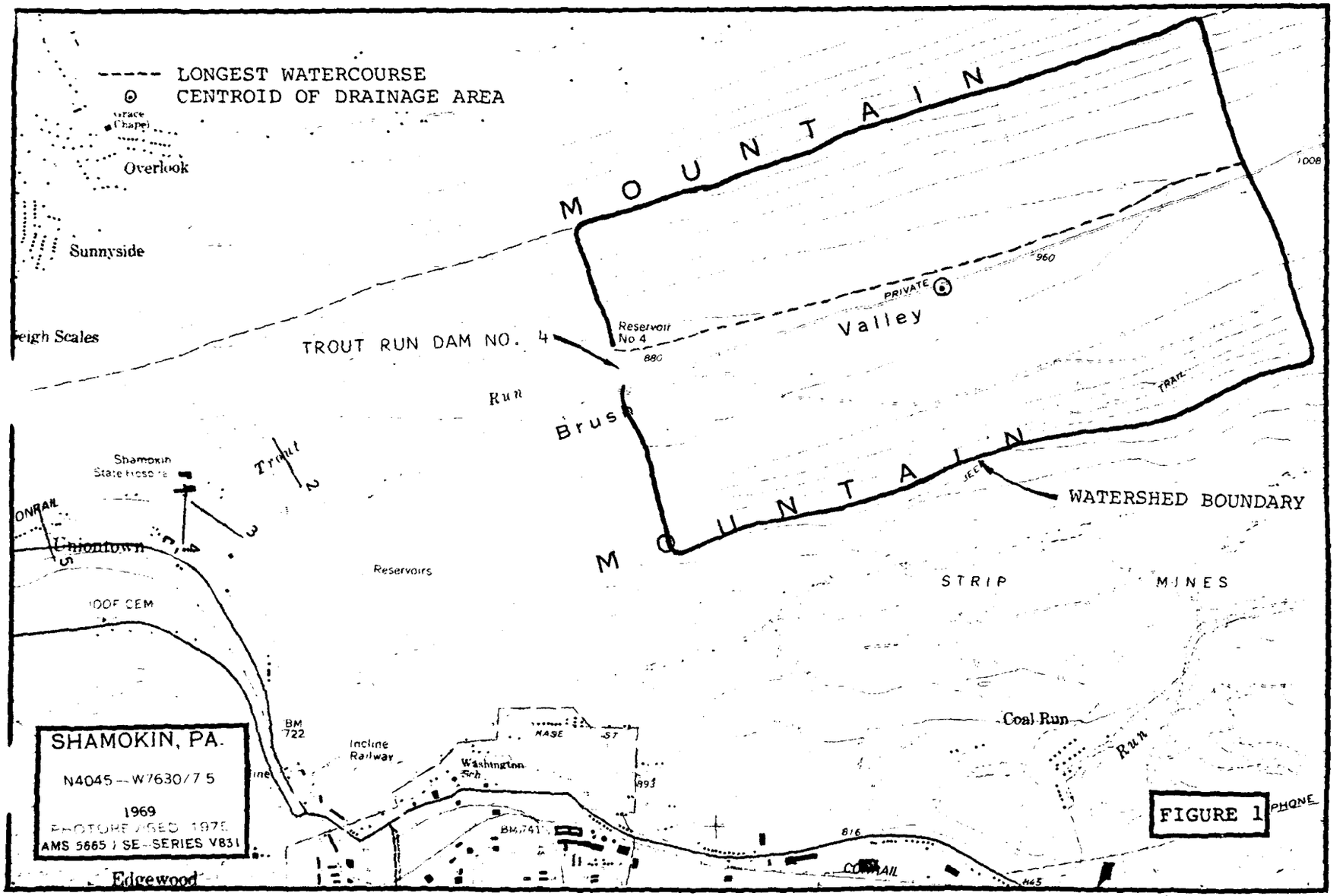
14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

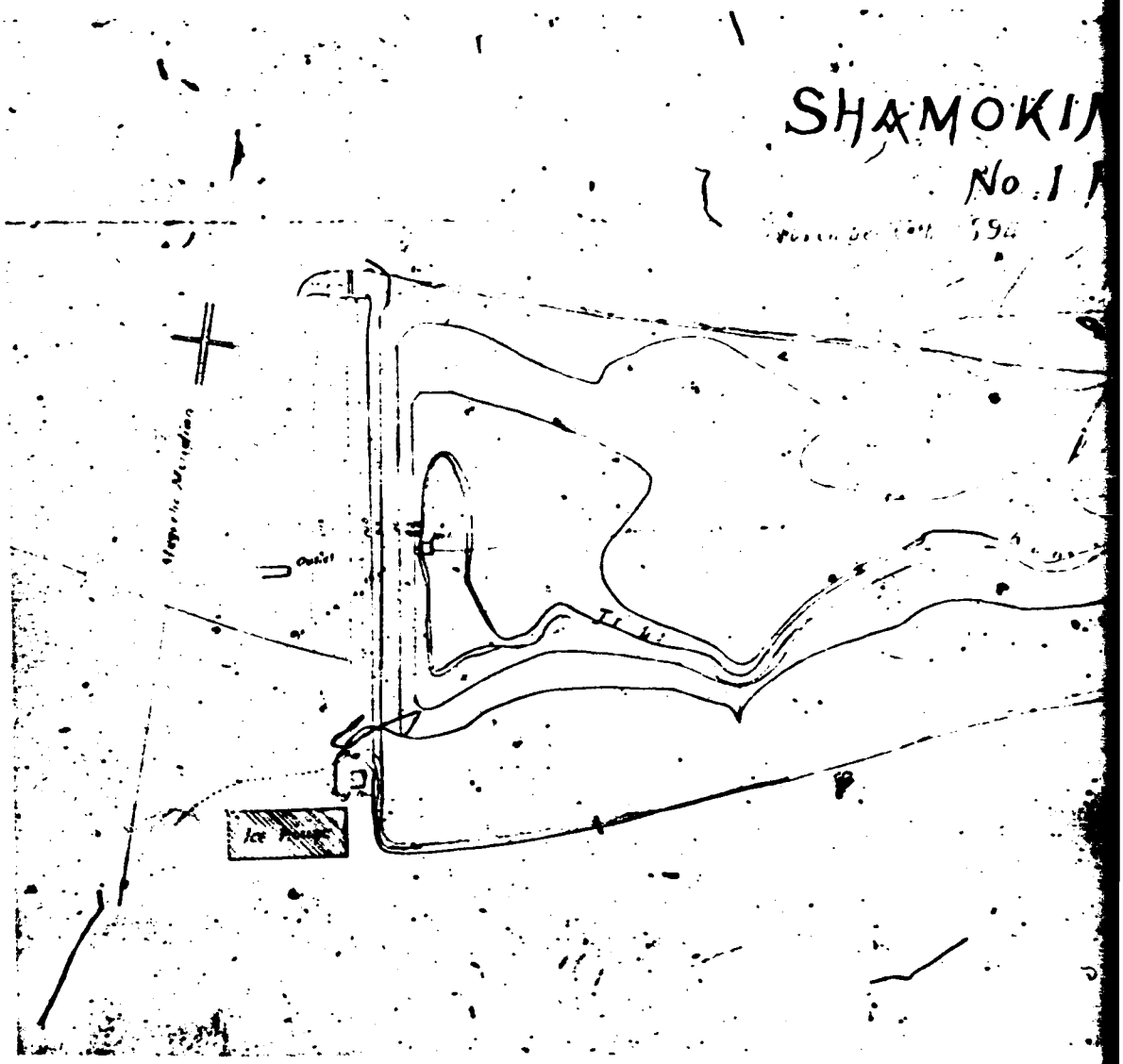
15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

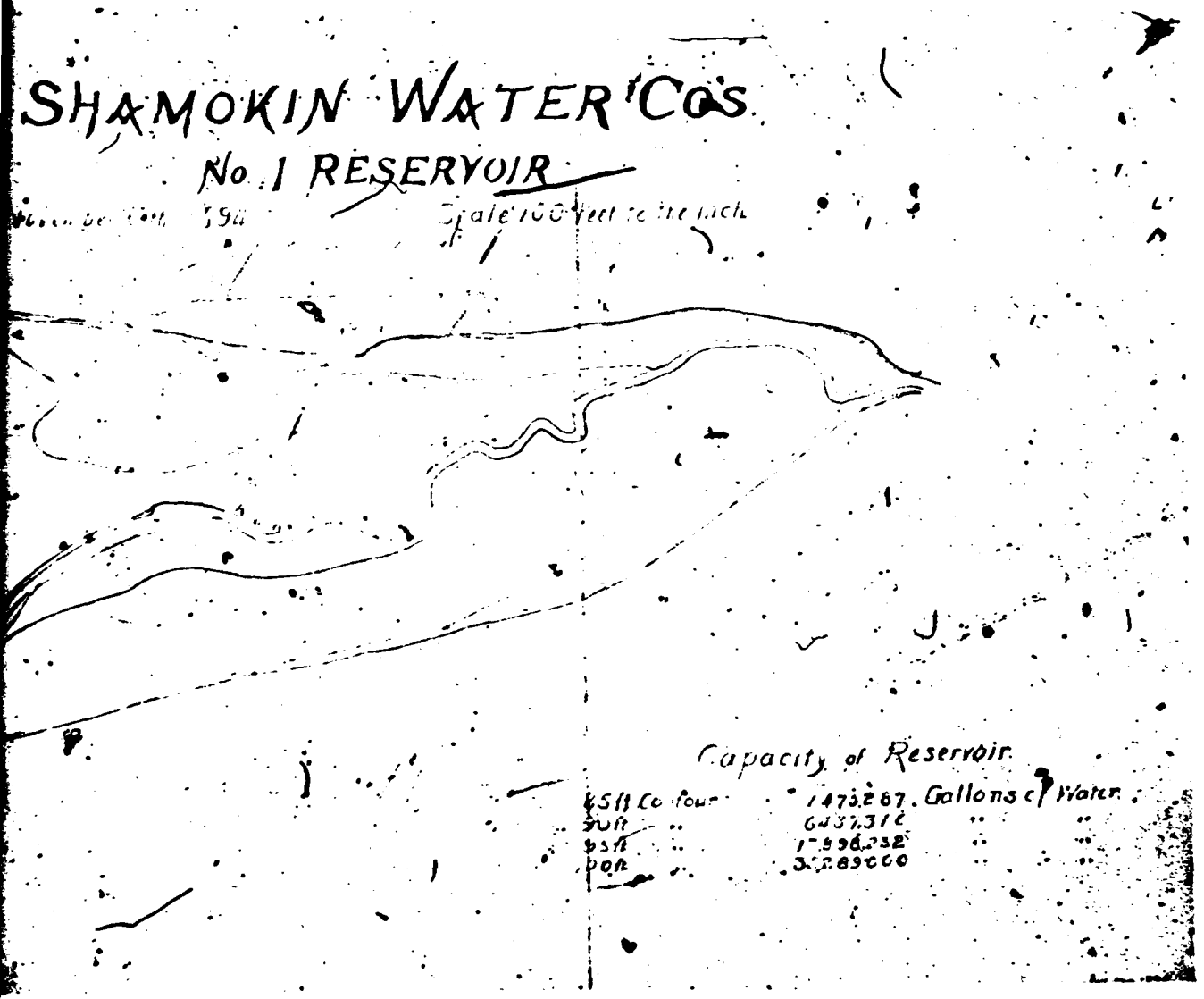
APPENDIX E

FIGURES

LIST OF FIGURES

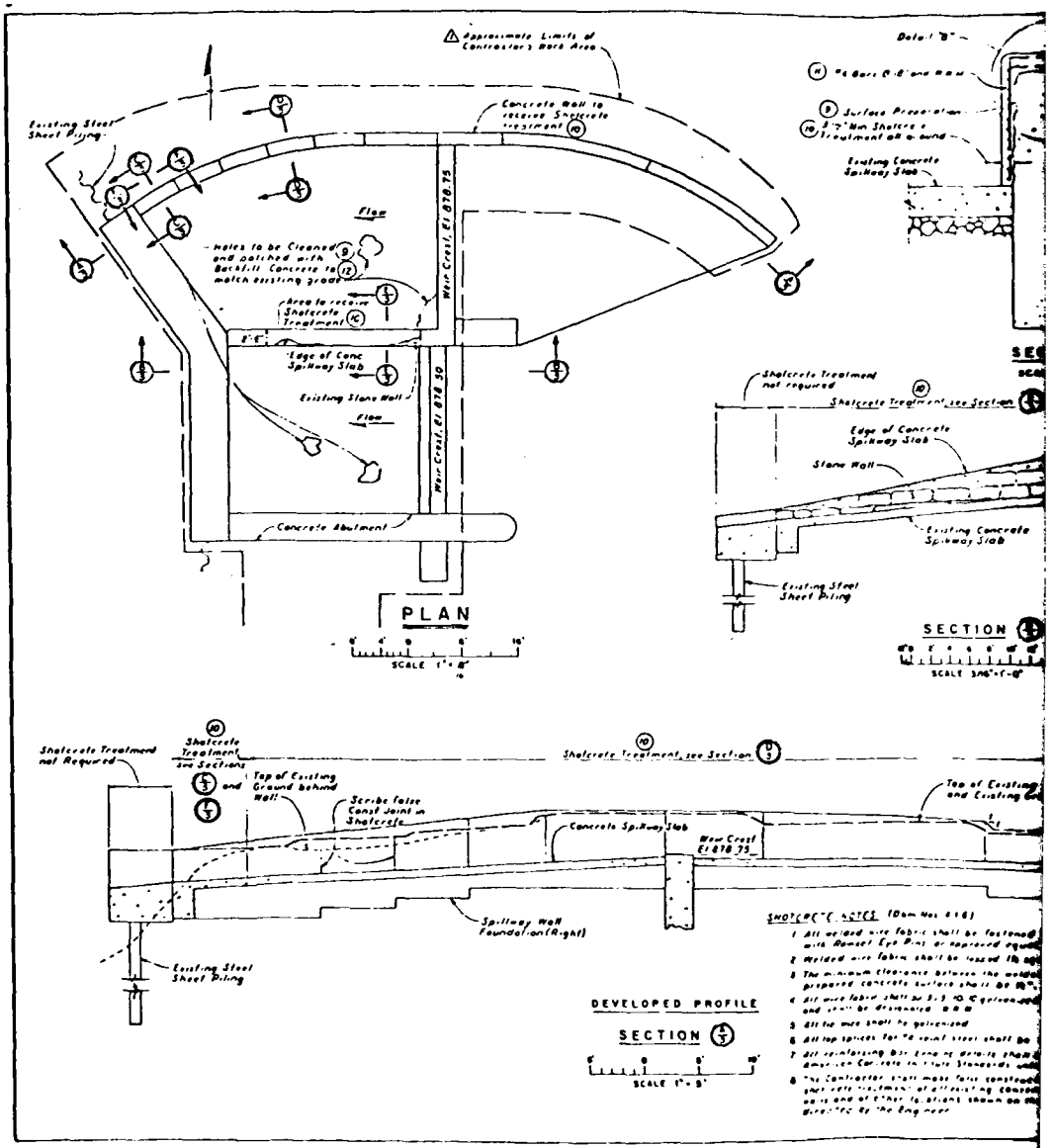

LONGEST WATERCOURSE
CENTROID OF DRAINAGE AREA
MOUNTAIN
Overlook
Sunnyside
TROUT RUN DAM NO. 4
Reservoir No 4
Valley
PRIVATE
960
880
Run
Brush
MOUNTAIN
TRAIL
WATERSHED BOUNDARY
Shamokin State Forest
Trout
Unionto
Reservoirs
STRIP MINES
IOOF CEM
BM 722
Incline Railway
Washington Sch
BM 741
816
Coal Run
Run
Edgewood
SHAMOKIN, PA.
N4045--W7630/7 5
1969
PHOTOREVISED 1975
AMS 5665 / SE--SERIES V831
FIGURE 1

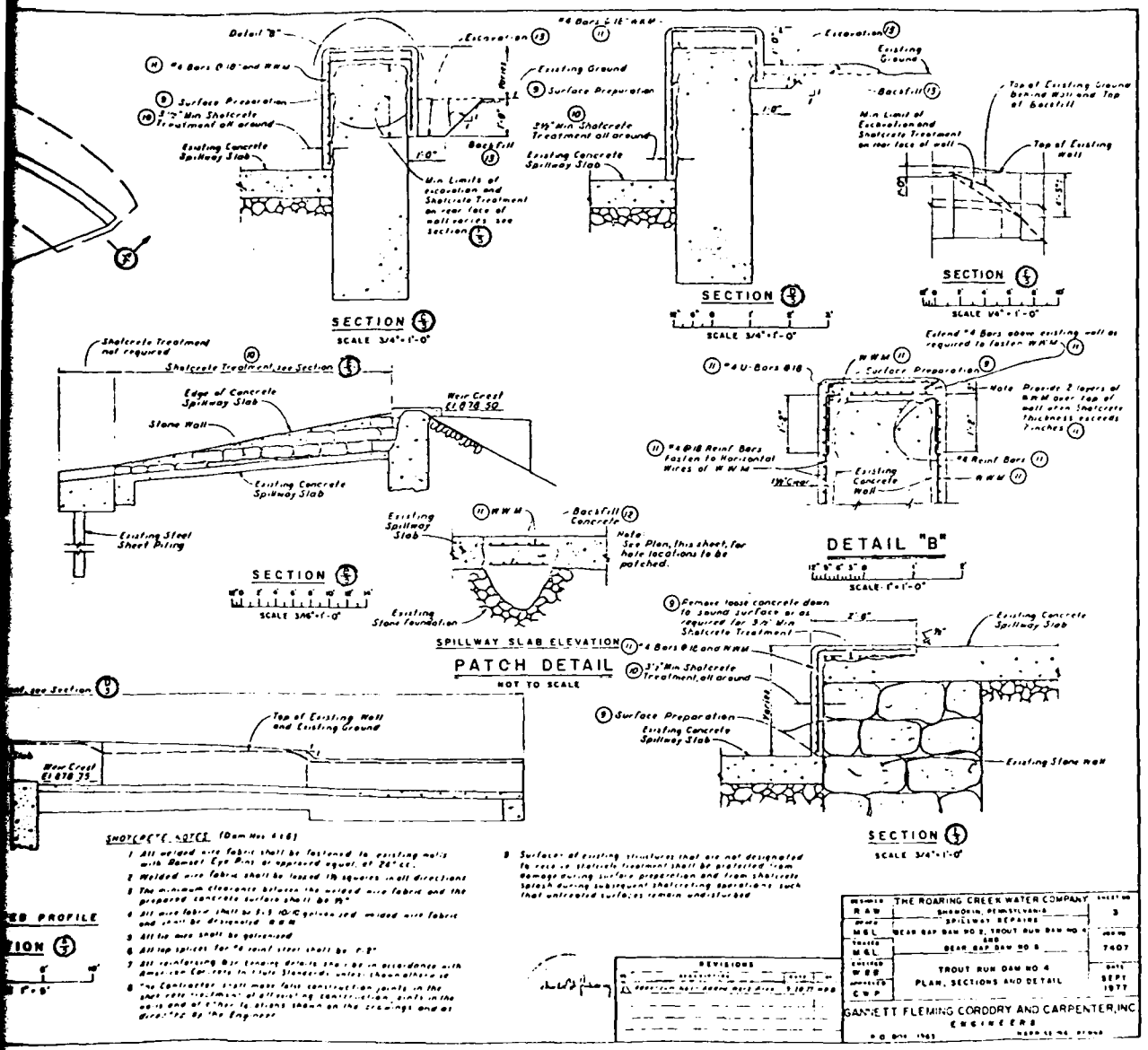

SHAMOKI
No. 1
Ice House



GAI CONSULTANTS, INC.

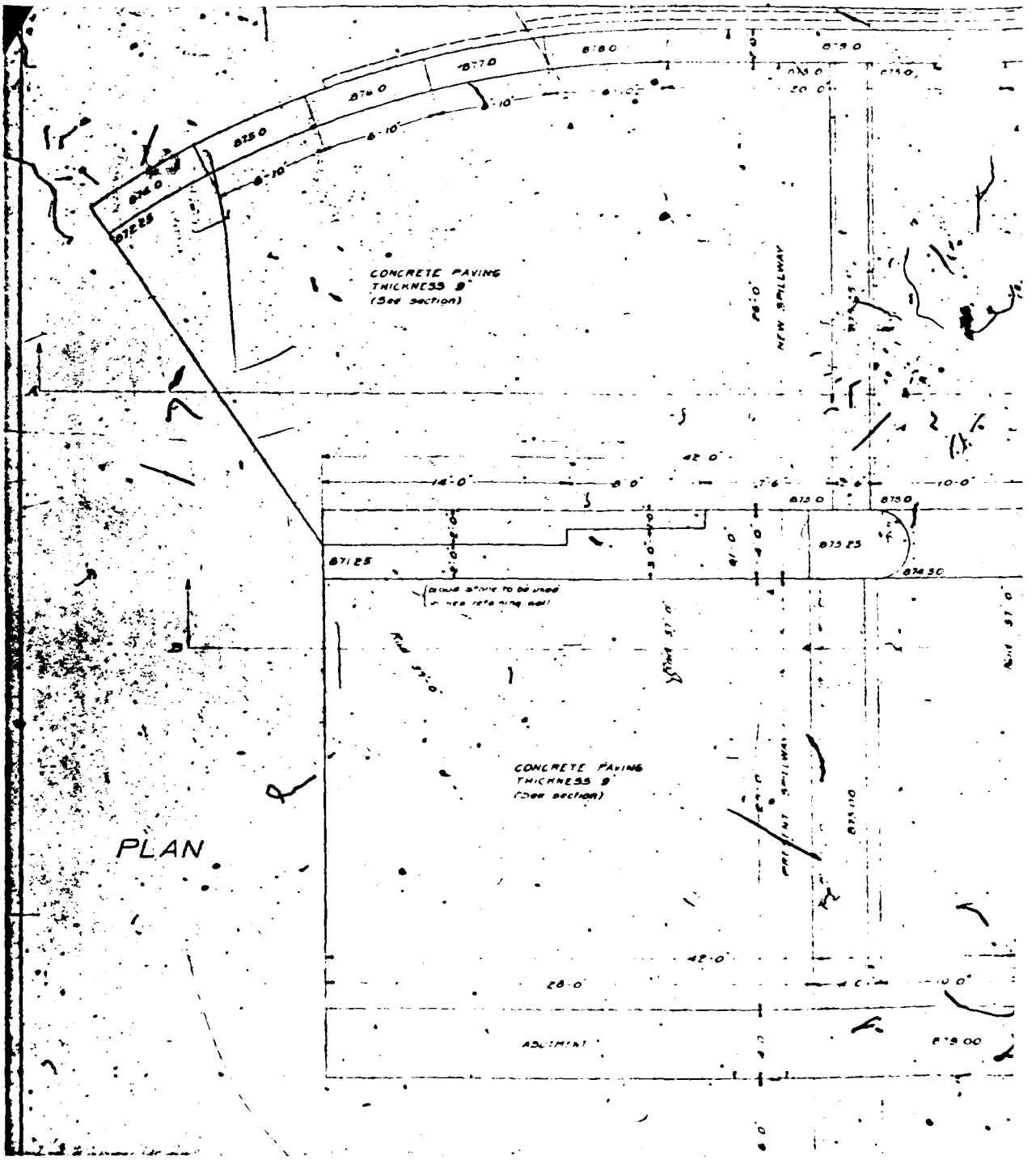
FIGURE 2

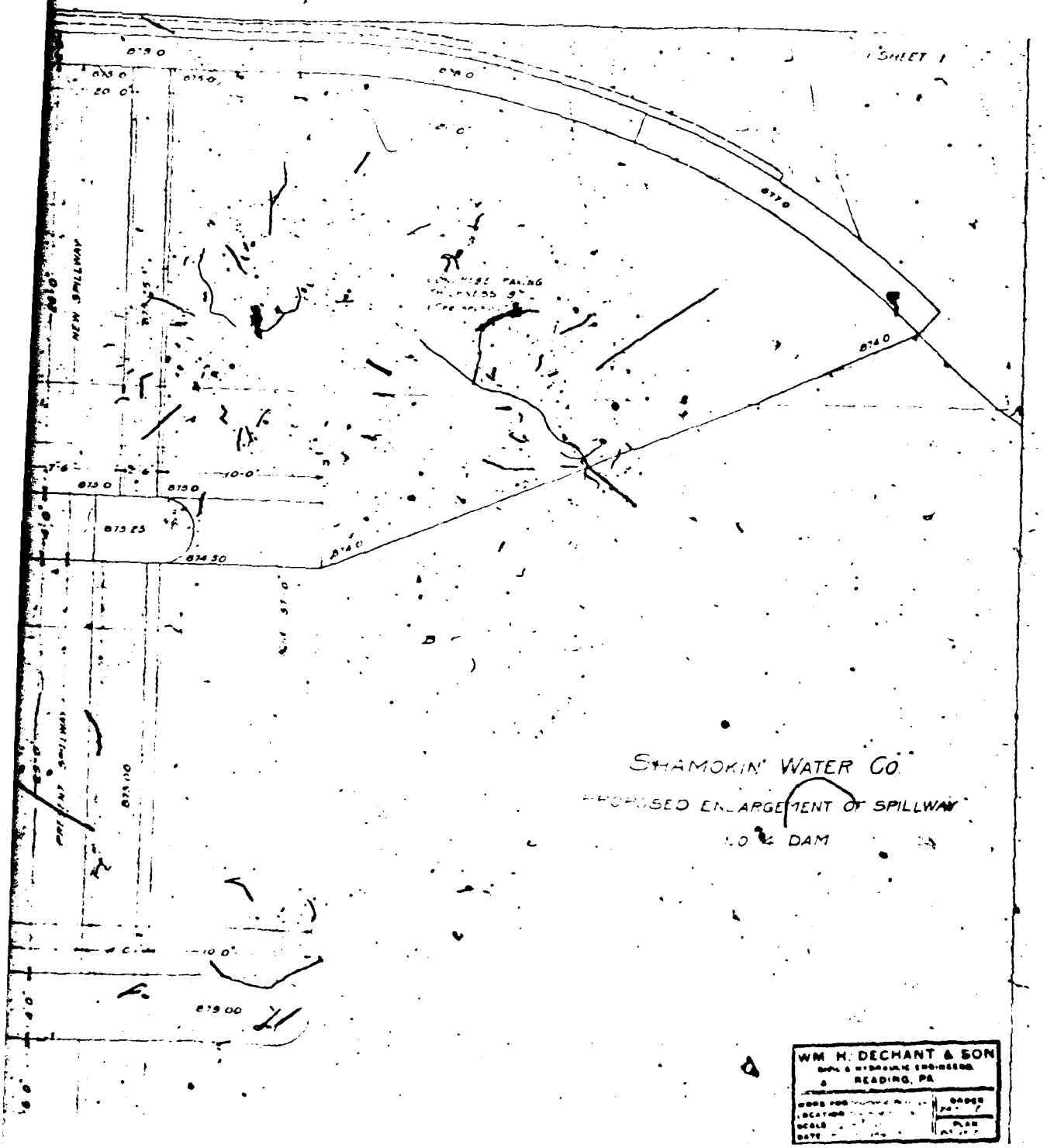

Approximate Limits of Contractor's Work Area
Existing Steel Sheet Piling
Concrete Wall to receive Shotcrete treatment
Flow
Holes to be Cleaned and patched with Backfill Concrete to match existing grade
Area to receive Shotcrete Treatment
Weir Crest, El 878.75
Edge of Conc Spillway Slab
Existing Stone Wall
Weir Crest, El 878.30
Concrete Abutment
PLAN
SCALE 1"=8'
Shotcrete Treatment not required
Shotcrete Treatment, see Section
Edge of Concrete Spillway Slab
Stone Wall
Existing Concrete Spillway Slab
Existing Steel Sheet Piling
SECTION
SCALE 3/16"=1'-0"
Shotcrete Treatment not Required
Shotcrete Treatment see Sections and
Top of Existing Ground behind Wall
Scribe false Const Joint in Shotcrete
Concrete Spillway Slab
Weir Crest El 878.75
Spillway Wall Foundation (Right)
Existing Steel Sheet Piling
DEVELOPED PROFILE
SECTION
SCALE 1"=8'
SHOTCRETE NOTES (Dam Nos 6 to 8)



GAI CONSULTANTS, INC.

FIGURE 3


CONCRETE PAVING
THICKNESS 9"
(See section)
NEW SPILLWAY
CONCRETE PAVING
THICKNESS 9"
(See section)
PLAN



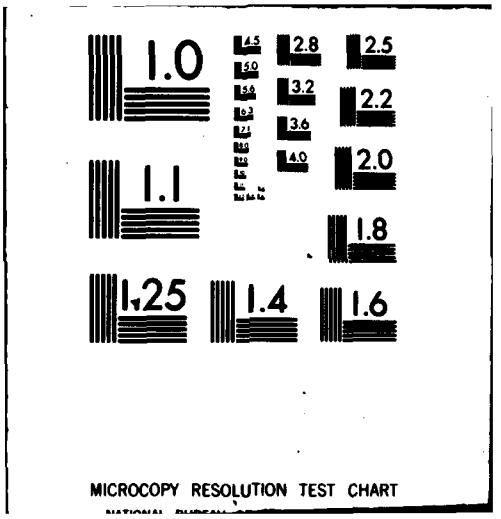
CONSULTANTS, INC.

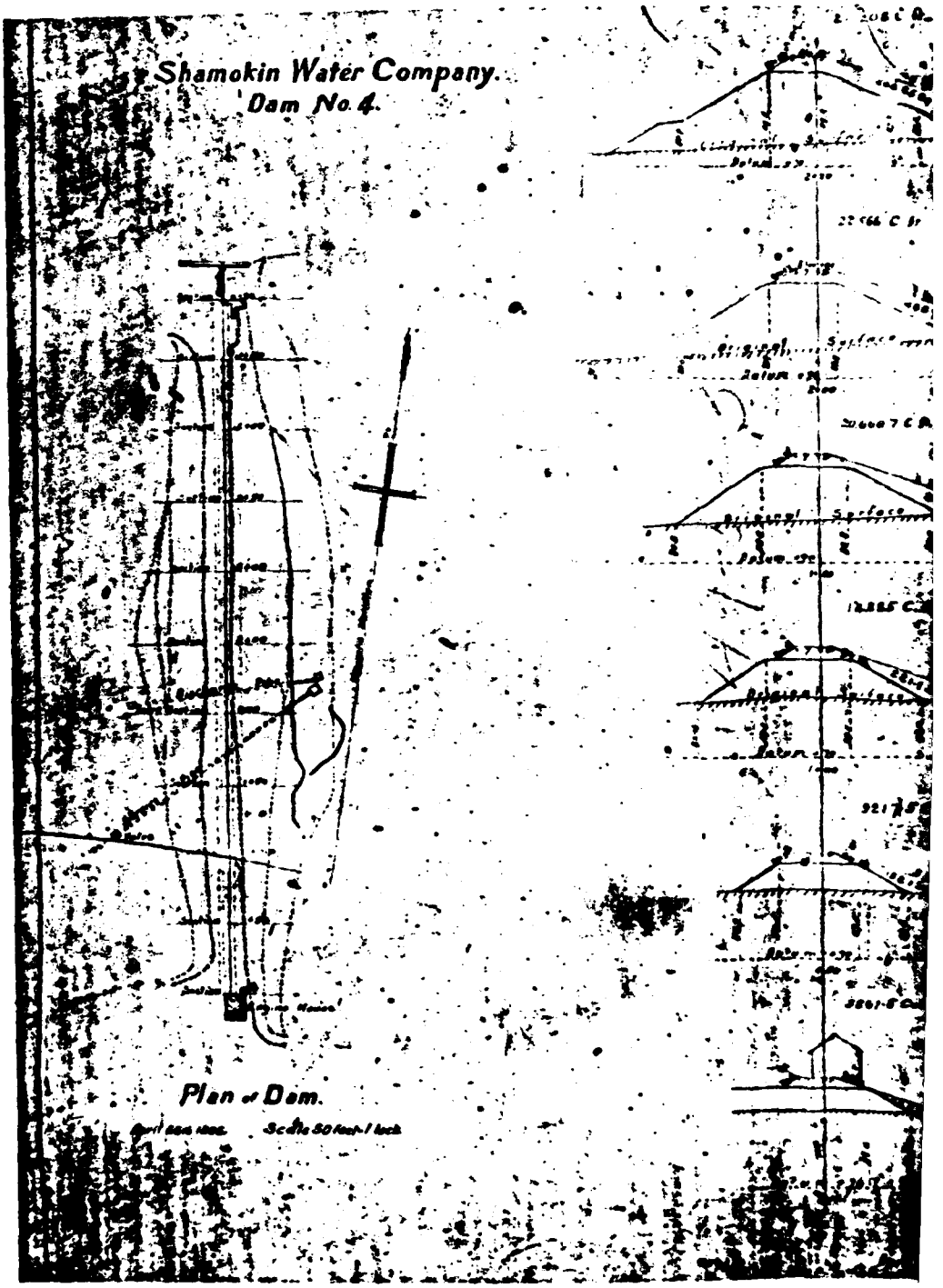
FIGURE 4

AD-A082 109 GAI CONSULTANTS INC MONROEVILLE PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. TROUT RUN DAM NUMBER 4. (NDI N--ETC(U)
JAN 80 DACW31-80-C-0016
UNCLASSIFIED NL

2 - 2

END
DATE FILMED
4-80
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART


Shamokin Water Company.
Dam No. 4.
Plan of Dam.

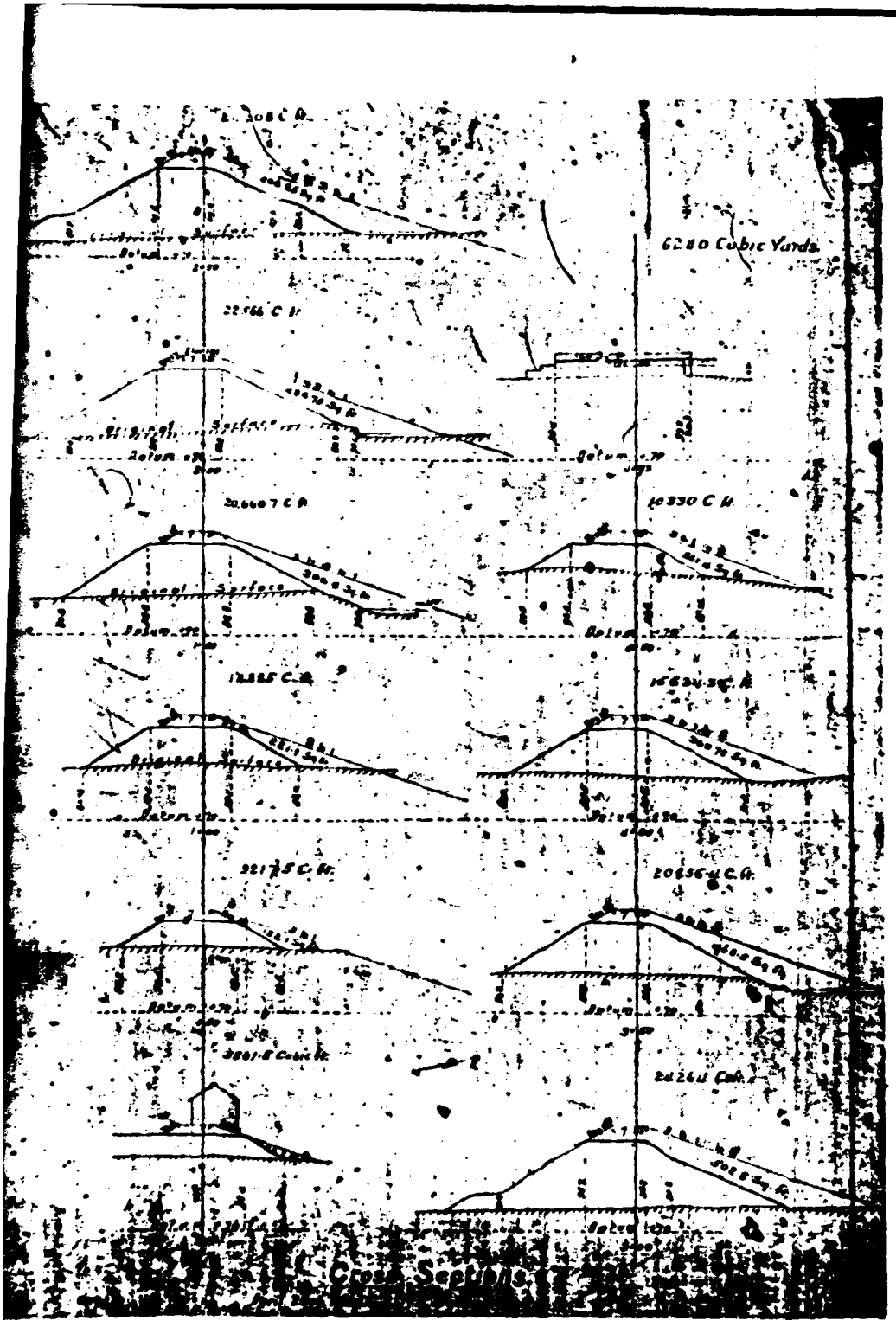


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FIGURE 5

APPENDIX F

GEOLOGY

Geology

Trout Run Dam No. 4 is located in the Appalachian Mountain section of the Valley and Ridge Physiographic Province of Pennsylvania.

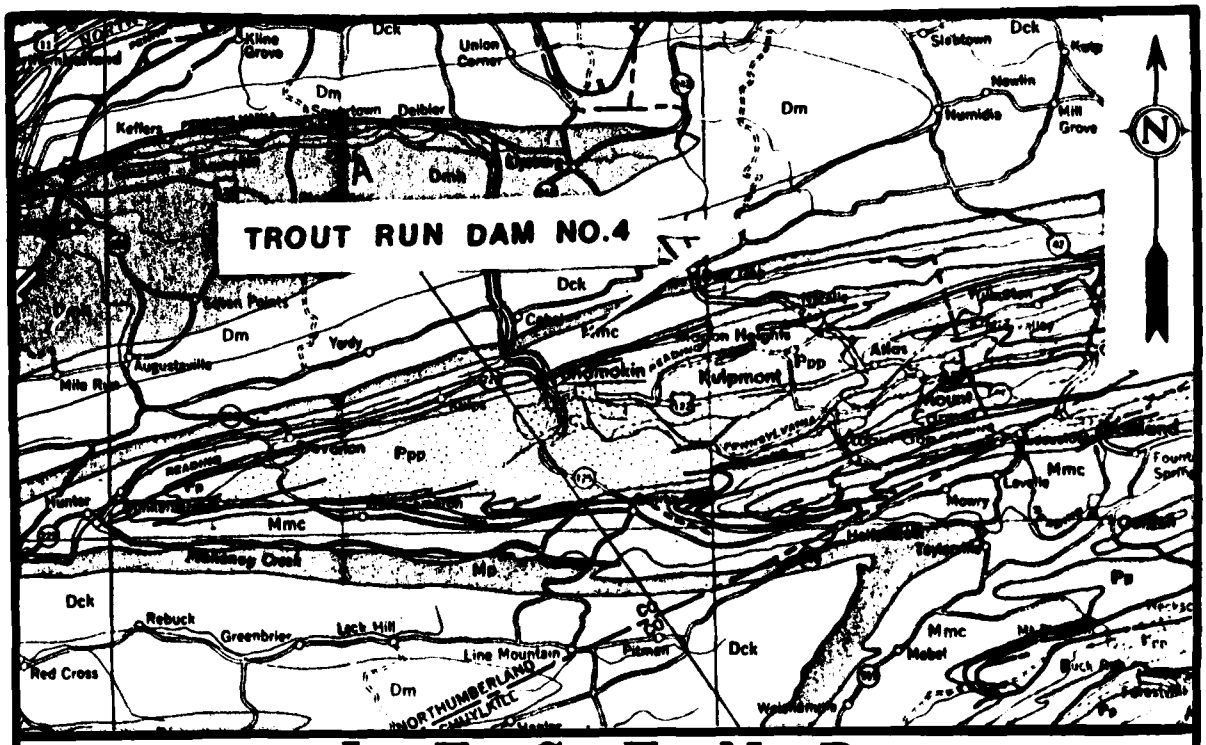
The dam is located on Trout Run in Brush Valley which is flanked on the north by Little Mountain and on the south by Big Mountain. The north flanking ridge rises 540 to 620 feet above the dam and reservoir, whereas the south flanking mountain rises 720 feet above the dam and reservoir.

Structurally, the site lies on the southeast flank of the Selinsgrove Anticlinorium, a broad structural feature trending in a southwest-northeast direction. Immediately south of the site over Big Mountain is the Western Middle Synclinorium containing the Pennsylvania age strata of the Western Middle Anthracite Coal Field. Intense tectonic forces from the southeast produced the many minor folds, flexures and faults typical of the region.

In the vicinity of the dam, the bedrock dips from the right abutment (north) to the left abutment (south) at approximately 35 to 40 degrees. A small, strike-slip fault has been noted on the crest of Little Mountain about 2,000 feet north of the reservoir. The bedrock immediately underlying the dam and reservoir consists of Mississippian age sandstone, siltstone, mudstone and shale, generally thin to medium bedded, very fine to medium grained with grayish-red

and reddish brown sandstone interbedded with similarly colored siltstone, mudstone and shale. Bedrock in Brush Valley is generally concealed by a thick soil mantle and vegetative growth.

Arndt, Harold, et. al., "Geologic Map of the South Half of the Shamokin Quadrangle, Northunberland and Columbia Counties, Pennsylvania," United States Geological Survey, Miscellaneous Geologic Investigations, Map 1-734, 1973.



L E G E N D

PENNSYLVANIAN

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous minable coals.

Pp — **Pottsville Group**
Light gray to white, coarse grained sandstones and conglomerates with some minable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**
Red shales with brown to greenish gray flaggy sandstones, includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties. Loyalhanna Limestone at the base in southwestern Pennsylvania.

Mp — **Pocono Group**
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale, includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Canewango, Corry, and Knapp Formations, includes part of "Chemung" of M.L. Fuller in Potter and Tioga counties.

DEVONIAN

UPPER

CENTRAL AND EASTERN PENNSYLVANIA

Dck — **Catskill Formation**
Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east

Dm — **Marine beds**
Gray to olive brown shales, greywackes, and sandstones, contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock. Tully Limestone at base

MIDDLE AND LOWER

Dmh — **Mahantango Formation**
Brown to olive shale with interbedded sandstones which are dominant in places (Montebello), highly fossiliferous in upper part, contains "Centerfield coral bed" in eastern Pennsylvania

Scale

0 2 4 6 8 10 MILES

REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

GEOLOGY MAP

GAI CONSULTANTS, INC.